Geol Survey

Guide to the geology of the Oregon area, Ogle County

David L. Reinertsen

Field Trip Guidebook 1990C, September 29
Department of Energy and Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
Champaign, Illinois 61820

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Geological Science Field Trips The Educational Extension Unit of the Illinois State Geological Survey conducts four free tours each year to acquaint the public with the rocks, mineral resources and landscapes of various regions of the state and the geological processes that have led to their origin. Each field trip is an all-day excursion through one or more Illinois counties. Frequent stops are made to explore interesting phenomena, explain the processes that shape our environment, discuss principles of earth science, and collect rocks and fossils. People of all ages and interests are welcome. The trips are especially helpful to teachers in preparing earth science units. Grade school students are welcome, but each must be accompanied by a parent or guardian. High school science classes should be supervised by at least one adult for each ten students.

With this field trip program, we hope to stimulate a general interest in the geology of Illinois and a greater appreciation of the state's vast mineral resources and their importance to the economy. A list of earlier field trip guide leaflets for planning class tours and private outings may be obtained by contacting the Educational Extension Unit, Illinois State Geological Survey, Natural Resources Building, 615 East Peabody Drive, Champaign, IL 61820. Telephone: (217) 244-2407 or 333-7372.

Please Note Several of the stops in the itinerary for this field trip are on private property. The owners have graciously given us permission to visit their lands. Please obey all instructions from the trip leaders and conduct yourselves in a manner that respects the property owners' cooperation. So that we may be welcome to return on future field trips, please do not litter or climb on fences, and leave all gates as you found them. These simple rules of courtesy also apply to public property. Because of trespass laws and liability constraints, you *must* get permission from property owners, or their agents, before entering private property.

Cover photographs: Ordovician St. Peter Sandstone exposures south of Oregon.

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INTRODUCTION

The Oregon field trip area is in Ogle County some 20 miles southwest of Rockford. The area is in a region of central-northern Illinois commonly referred to as the Rock River country. This guide is intended to acquaint you with the geology, landscape, and mineral resources of this area. The scenic Rock River cuts through the area from north to south on its way to the Mississippi River. In the foreword to his book *The Rock River Country of Northern Illinois*, Deete Rolfe (1929) wrote:

> There are many ways of enjoying the beauties of Nature. One is the simple delight of the eye in contour and coloring. A . . . wooded hillside, a moss-covered cliff, a misty waterfall . . . all of these make very direct appeal to the eye and give a distinct sense of pleasure. Often they lift one . . . to a higher plane of life.
>
> To this appeal to the eye and the emotions, there may be added an intellectual appeal, to be gained through some understanding of the many and varied forces of Nature which have entered into the making of the landscape, and of the way in which they have worked through the ages. The result is increased enjoyment and appreciation of the scenery. Intelligent appreciation always comes as a result of understanding . . . .
>
> In Illinois there are many places worthy of such appreciative enjoyment, and they represent a large number of different types of landscape beauty . . . . Some of the places are of considerable extent; others are in miniature-like clear-cut cameos. All of them should be treasured, and their beauty should be regarded as a heritage to be preserved and handed down from generation to generation.
>
> The area along Rock River between Beloit and Dixon . . . is a region of great natural charm, presenting as it does a rare succession of places of unusual and varied beauty. All along . . . (this) stretch of river are pictures which delight the eye, engage the interest and repay in bounteous measure every effort on the part of man to understand the forces that have operated in the making of the landscape . . . .

GEOLOGIC FRAMEWORK OF THE OREGON AREA

Bedrock The Oregon area, like most of Illinois, has undergone many changes through all of the thousands of millions of years of geologic time (fig. 1). The oldest rocks beneath us on the field trip belong to the ancient Precambrian "basement complex." We know relatively little about these rocks from direct observations because they are not exposed at the Earth's surface anywhere in Illinois. Only a few drill holes have reached deep enough—nearly 3,000 feet in this part of the state—for geologists to collect samples from Precambrian rocks. From these samples, however, we know that these ancient rocks consist mostly of igneous and metamorphic rocks of granitic composition formed some 1.0 to 1.5 billion years ago. Though geologists seldom see these rocks, they can determine some of the characteristics of the basement complex through the use of various geophysical techniques, such as measuring magnetic fields that are affected by iron-bearing minerals in the basement.

Era		Period or System and Thickness	Epoch	Age (years ago)	General Types of Rocks
CENOZOIC "Recent Life"	Age of Mammals	Quaternary 0-500'	Holocene	10,000	Recent—alluvium in river valleys
			Pleistocene Glacial Age	1.6 m.	Glacial till, glacial outwash, gravel, sand, silt, lake deposits of clay and silt, loess and sand dunes; covers nearly all of state except northwest corner and southern tip
		Tertiary 0-500'	Pliocene	5.3 m. 36.6 m.	Chert gravel, present in northern, southern, and western Illinois
			Eocene	57.8 m.	Mostly micaceous sand with some silt and clay, present only in southern Illinois
			Paleocene	66.4 m.	Mostly clay, little sand; present only in southern Illinois
MESOZOIC "Middle Life"	Age of Reptiles	Cretaceous 0-300'		144 m. 286 m.	Mostly sand, some thin beds of clay and, locally, gravel; present only in southern Illinois
PALEOZOIC "Ancient Life"	Age of Amphibians and Early Plants	Pennsylvanian 0-3,000' ("Coal Measures")		320 m.	Largely shale and sandstone with beds of coal, limestone, and clay
		Mississippian 0-3,500'		360 m.	Black and gray shale at base; middle zone of thick limestone that grades to siltstone, chert, and shale; upper zone of interbedded sandstone, shale, and limestone
	Age of Fishes	Devonian 0-1,500'		408 m.	Thick limestone, minor sandstones and shales; largely chert and cherty limestone in southern Illinois; black shale at top
	Age of Invertebrates	Silurian 0-1,000'		438 m.	Principally dolomite and limestone
		Ordovician 500-2,000'		505 m.	Largely dolomite and limestone but contains sandstone, shale, and siltstone formations
		Cambrian 1,500-3,000'		570 m	Chiefly sandstones with some dolomite and shale, exposed only in small areas in north-central Illinois
ARCHEOZOIC and PROTEROZOIC					Igneous and metamorphic rocks, known in Illinois only from deep wells

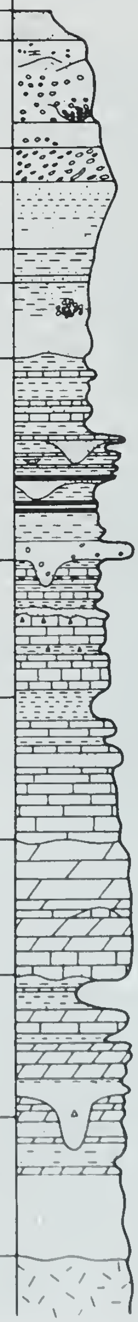


Figure 1 Generalized geologic column showing succession of rocks in Illinois.

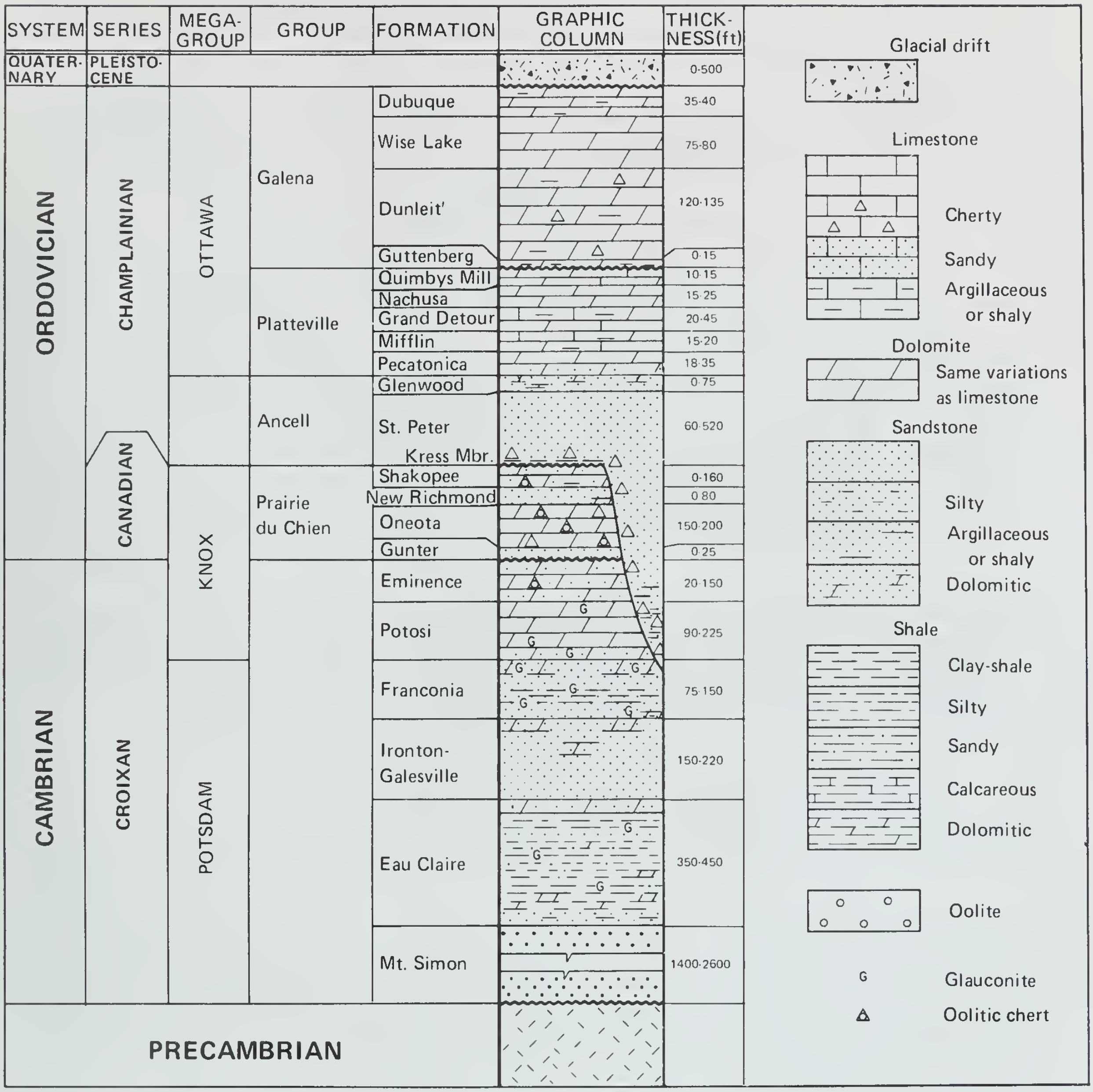


Figure 2 Geologic column of the study area.

The basement rocks in the Oregon area are now covered by about 2,900 to 3,200 feet of sedimentary rocks and glacial deposits. The Paleozoic Era lasted from about 570 million years ago to about 245 million years ago. The Cenozoic began about 65 million years ago. During most of the Paleozoic Era, shallow seas repeatedly inundated the interior regions of what is now our continent. Shells of marine animals, muds, silts, and sands deposited in those seas through time were gradually buried and lithified into solid rocks of limestone and dolomite, shale, siltstone, and sandstone.

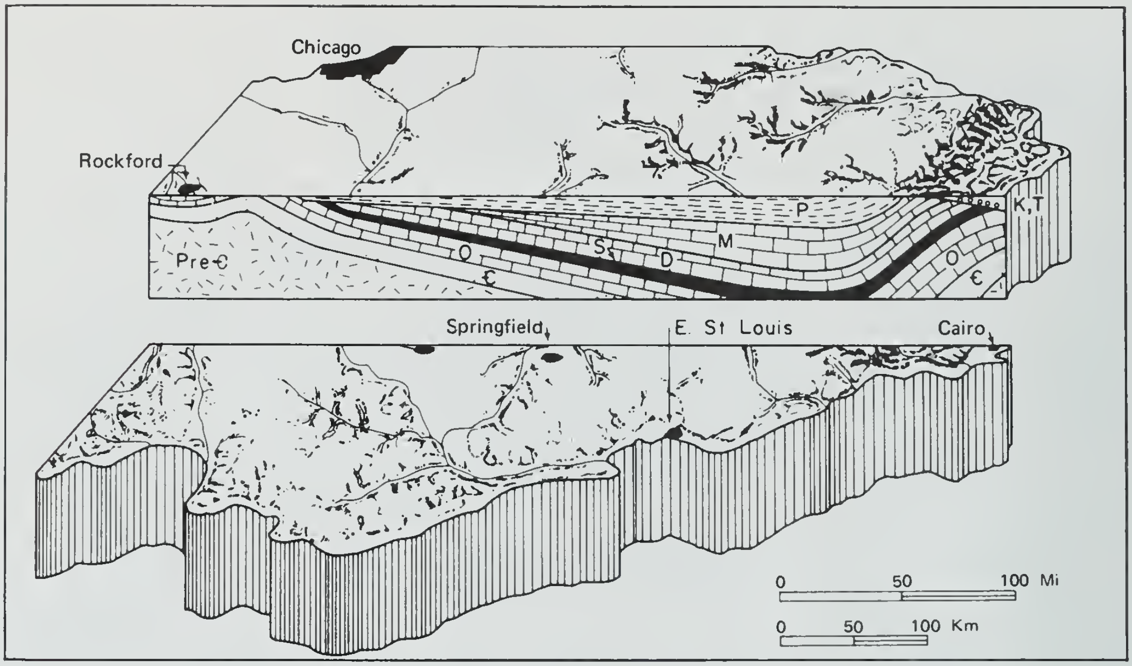


Figure 3 Stylized north-south cross section shows the structure of the Illinois Basin. The thickness of the sedimentary rocks is greatly exaggerated to show detail, and the young, unconsolidated surface deposits have been eliminated. The oldest rocks, Precambrian (Pre-C) granites, form a depression filled with layers of sedimentary rocks of various ages: Cambrian (C), Ordovician (O), Silurian (S), Devonian (D), Mississippian (M), Pennsylvanian (P), Cretaceous (K), and Tertiary (T). The scale is approximate.

The geologic column in figure 2 shows the succession of rock strata that a drill bit would encounter in this area (the oldest formations are at the bottom of the column). The oldest sediments began to settle to the sea floor about 525 million years ago during the Cambrian Period of the Paleozoic Era. Figure 3 shows the general thickness of sedimentary rocks in Illinois.

The youngest Paleozoic rocks in the field trip area are Ordovician in age, formed from sediments that accumulated up to perhaps 440 million years ago. However, evidence from nearby areas strongly suggests that Paleozoic strata younger than Ordovician once covered the field trip area. For example, Pennsylvanian strata, which have not been found here, only lie about 20 to 35 miles south, near the Illinois River. Pennsylvanian rocks also were identified in cores from holes drilled into the Des Plaines Disturbance structure about 75 miles to the east and slightly north of here (fig. 4; Reinertsen 1987C). These two outcrops suggest that Pennsylvanian strata at one time may have extended across the Oregon area. Indirect evidence from the ranks of coals in La Salle and Grundy Counties, some 60 miles southeast of the field trip area, indicates that perhaps 3,000 feet or more of Late Pennsylvanian and younger strata once covered northern Illinois (Damberger 1971). Millions of years of erosion has removed all traces of these rocks, leaving some large gaps in the rock record. Farther south in Illinois, at least 15,000 feet of Paleozoic sedimentary strata accumulated (fig. 3).

Figure 4 shows the major bedrock units in Illinois as they would appear if all the glacial deposits were scraped off. Bedrock exposures are limited essentially to outcrops along the Rock River and its tributary stream cuts, highway and railroad cuts, and quarries. Rocks of the

Ordovician System (figs. 2 and 4) occur at or just below the surface over most of the trip area.

Sedimentary rocks are classified by formation. A geological formation is a set of rocks distinctive enough to be readily recognizable in the field and widespread and thick enough to be plotted on a map. Because they are so similar in appearance and composition in northern Illinois, several sequences of formations are generally classified and mapped together in a unit called a group (see fig. 2).

Many of the formations in these groups have conformable contacts; that is, no significant interruptions in deposition took place between formations (fig. 2). In some instances, even though the composition and appearance of the rocks change significantly at the contact between two formations, the fossils in the rocks and the relationships between the rocks at the contact indicate that deposition was essentially continuous. At other contacts, however, the lower formation has been subjected to weathering and was at least partly eroded away before the overlying formation was deposited. The fossils and other evidence in the formations indicate that there was a significant gap between the time when the lower unit was deposited and the time when the overlying unit was laid down. This type of contact is called an unconformity. Where the beds above and below an unconformity are essentially parallel, the unconformity is called a disconformity; where the lower beds have been tilted and eroded before the overlying beds were deposited, the contact is called an angular unconformity. (Unconformities are shown as undulating lines across the Rock Unit column of fig. 2.)

Following the Paleozoic Era, during the Mesozoic and Cenozoic Eras and before the onslaught of glaciation 1 to 2 millions years ago, the land surface that is now Illinois was exposed to weathering and erosion. This produced a series of deep valley systems carved into the gently tilted bedrock formations. The topography was then considerably subdued by the repeated advance and retreat of glaciers, which scoured and scraped the old erosion surface. All except the Precambrian rocks were exposed to this erosion.

Quaternary Geology About 1.6 million years ago, during the Pleistocene Epoch (the period commonly referred to as the Ice Age), continental glaciers—massive sheets of ice hundreds of feet thick—flowed slowly southward from Canada (see *Pleistocene Glaciations in Illinois* in the appendix). The last of these glaciers melted from northeastern Illinois near the close of Wisconsinan time, about 13,500 years before the present (B.P.). Although ice sheets covered parts of Illinois several times during the Pleistocene Epoch, the continental glaciers reached their southernmost extent in North America during the Illinoian glaciation about 270,000 years B.P. From centers of snow and ice accumulation in Canada, the glaciers extended as far south as northern Johnson County, approximately 300 miles south-southeast of here (fig. 5).

Until recently, glaciologists had assumed that ice thicknesses of a mile or more were reasonable for these glaciers. However, the ice may have been only about 2,000 feet thick maximum in the Lake Michigan Basin and on the order of 700 feet thick across most of the land surface. That conclusion is based on several lines of research evidence including: 1) the degree of consolidation and compaction of rock and soil materials that must have been under the ice; 2) comparisons between the inferred geometry and configuration of the ancient ice masses and those of present-day glaciers and ice caps; 3) comparisons between the mechanics of ice-flow in modern-day glaciers and ice caps and those inferred from detailed studies of the ancient glacial deposits, and 4) the amount of rebound of the Lake Michigan Basin from being depressed beneath the mass of the glacial ice.

The ice of the various glaciations was active and thick enough to intensely scour and remove

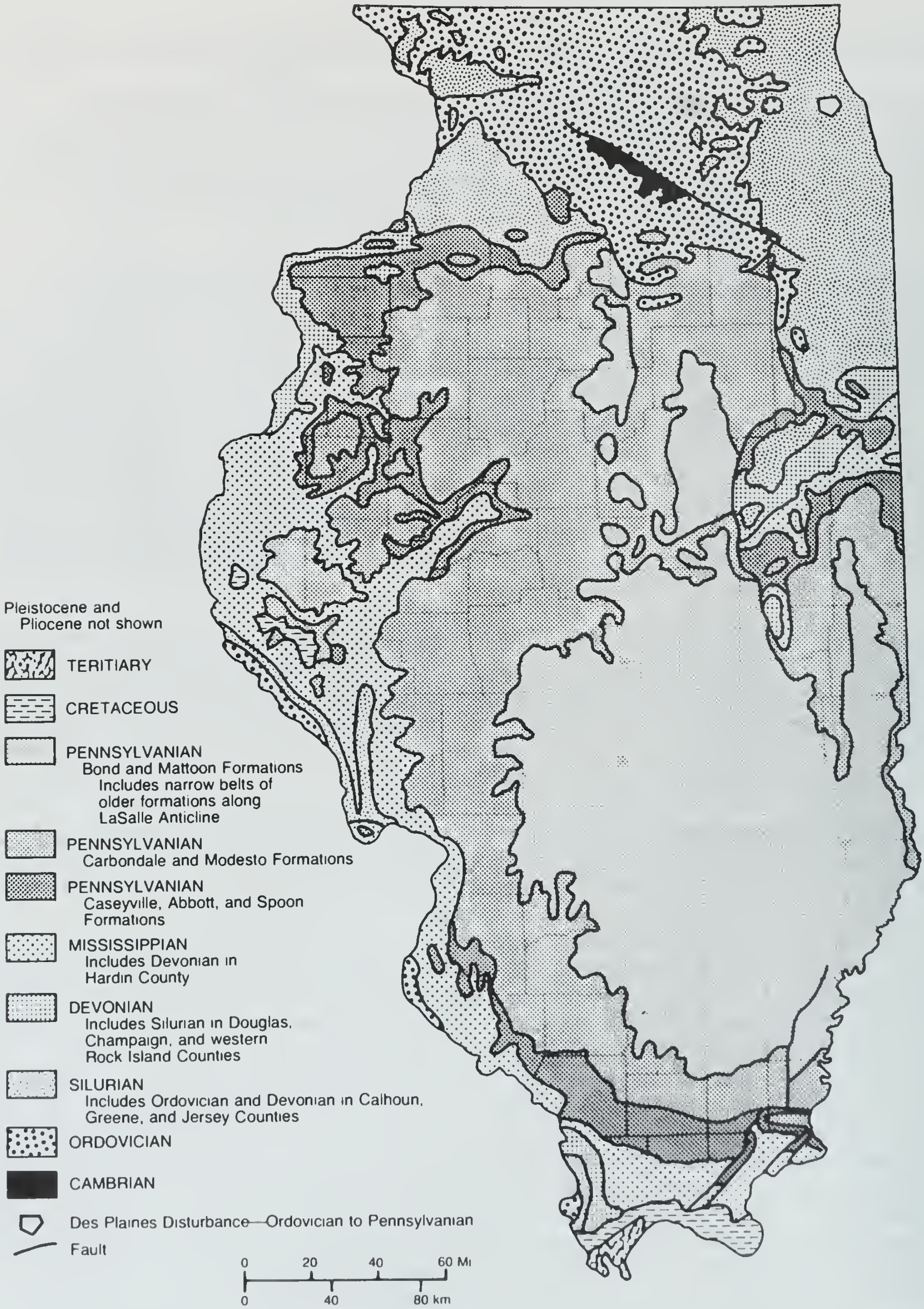


Figure 4 Geologic map of Illinois.

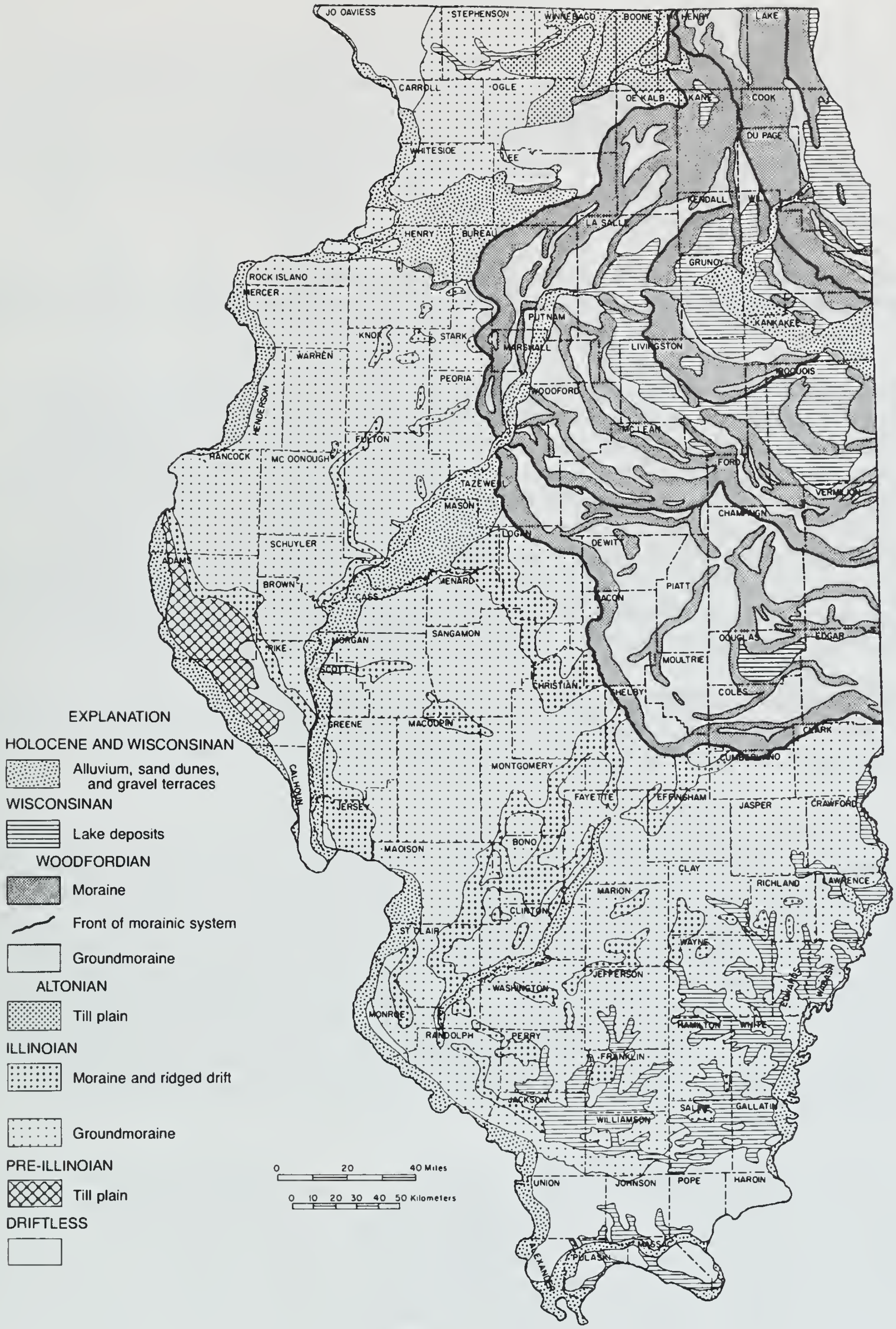


Figure 5 Generalized map of glacial deposits in Illinois (modified from Willman and Frye 1970).

part of the bedrock surface. Much of the evidence for pre-Illinoian and early Illinoian glaciations in the northern part of the state has been removed by the effects of the subsequent Wisconsinan glaciation. The last major glacial advance began during Wisconsinan Woodfordian time about 22,000 to 25,000 years B.P. Ice from an accumulation center in Labrador slowly flowed southward through the Lake Michigan Basin to form the Lake Michigan Glacial Lobe that spread out across northern Illinois. Figure 6 shows the classification of the Pleistocene materials in central-northern Illinois.

The thickness of sediments deposited by the glaciers (glacial drift) ranges from a few feet to somewhat more than 50 feet over much of the field trip area. Thicknesses greater than 300 feet occur in the buried Rock Valley in the eastern part of Ogle County.

The present landscape in the Oregon area is largely the result of deposition and erosion following the Monican Substage of the Illinoian Glacial Stage. The Illinoian surface and deposits have been modified somewhat by further erosion and deposition during post-Illinoian time, when Woodfordian glaciers of the Wisconsinan Substage stood to the east and north of the field trip area. The Woodfordian glacier reached its maximum westward extent about 21,000 years B.P., when it reached beyond Hennepin in Putnam County to block the ancient Mississippi River from its ancestral course south of the "great bend" of the present-day Illinois River. After establishing the Mississippi in its modern course, the ice front melted back, forming a series of end moraines to the east roughly paralleling the shore of Lake Michigan. (See *Pleistocene Glaciations in Illinois* in the appendix for a discussion of how moraines form.)

Huge volumes of meltwater released from the many miles of ice front in Wisconsin and central-northern Illinois coursed across this area during late Illinoian and early Wisconsinan (Altonian) times. This meltwater carved a new channel for the Rock River and altered the drainage pattern of the area.

Some of the more recent deposits in the field trip area are windblown silt (called loess; rhymes with "bus") and sand. The loess was winnowed and blown from the Wisconsinan outwash materials left along the floodplains of the rivers that were transporting the glacial meltwaters back to the sea. Each summer, floods of sediment-laden meltwater deposited new layers of mud, silt, sand, and gravel across the floodplains of the rivers. With the coming of winter, the amount of melting was reduced and floodplains that were water-covered during the summer were exposed to the bitter, drying winds of winter. The cold winds picked up huge clouds of dust from the floodplains and spread the fine material across the land. The Mississippi River was a major source of this loess, and the Rock River floodplain was a local source. Loess deposits with thicknesses ranging from about 4 to 9 feet help to subdue the topography of the eroded glacial materials.

Structural Setting and Tectonic History Figure 7 shows the locations of the major structural features (such as folds, arches, and faults) of the Oregon field trip area. In comparison with much of the northern part of Illinois, the structural geology of the Oregon area is unusually complex. More than 60 faults, with vertical displacements that range from a few inches to about 350 feet, are known in the area. Folds that have bent the rocks so that they dip 10° to 30° from their normal horizontal position are common, but they generally extend only a relatively short distance. The major structure in the area, the Ashton Arch, is a broad, high anticline (upward arching of the rocks) that brings Cambrian formations to the bedrock surface. The crest of the Arch can be traced from the Rock River between Oregon and Dixon southeastward for some 70 miles into Kendall County. The Ashton Arch is bounded on its north side by the Sandwich Fault Zone, which has a maximum cumulative displacement of about 800 feet about 40 miles

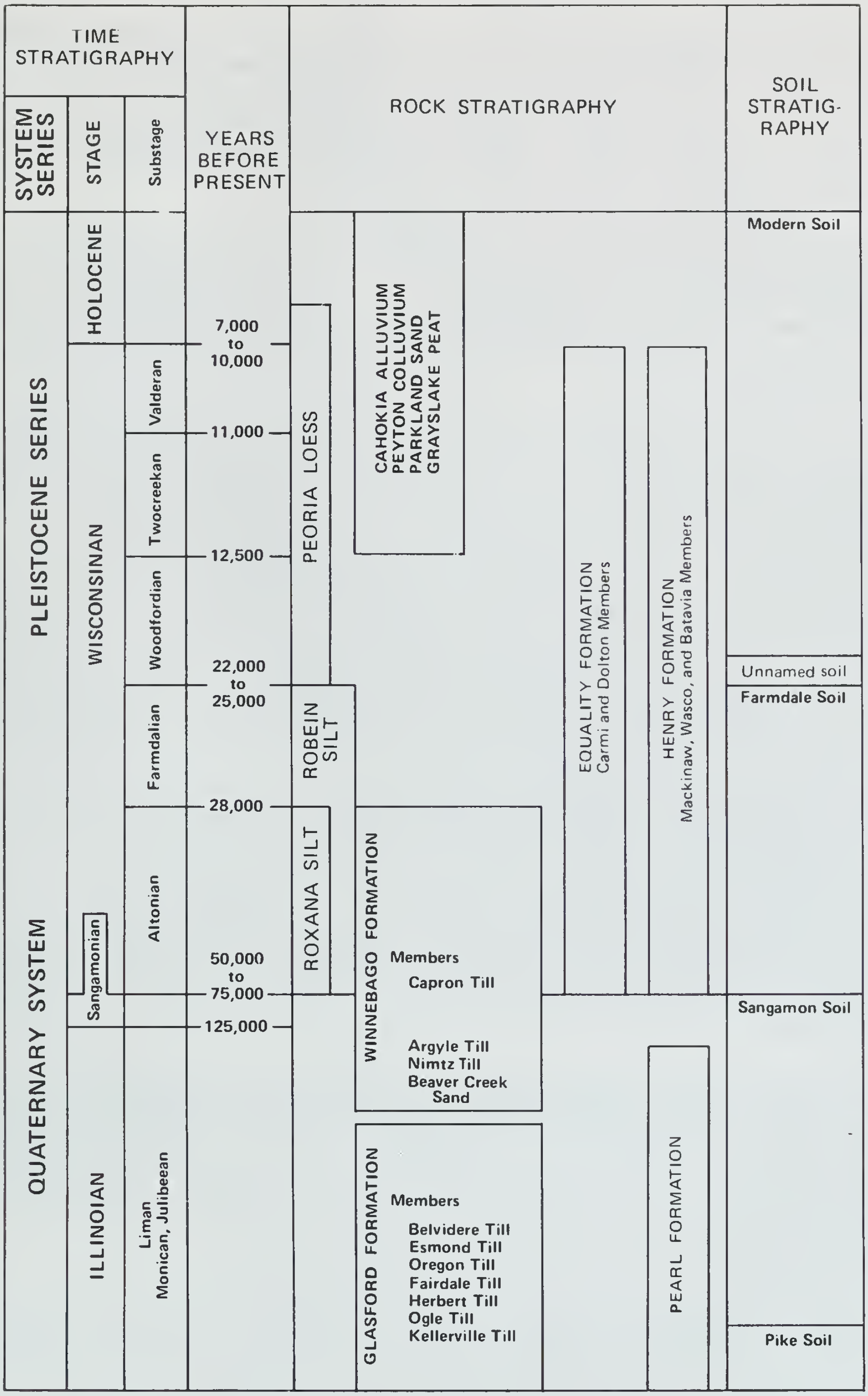


Figure 6 Stratigraphic classification of Quaternary deposits of central-northern Illinois.

southeast of here near Sandwich, in southeastern De Kalb County. The Sandwich Fault Zone, which extends southeastward from Oregon for about 85 miles to Manhattan, a few miles southeast of Joliet in Will County, is downthrown on the northeast side relative to the southwest side. The Oregon Anticline parallels the northwestern part of the Ashton Arch and is separated from it by the Sandwich Fault Zone. The Plum River Fault Zone and a syncline north of the Oregon Anticline separate the Oregon area from the Wisconsin Arch.

Although Paleozoic rocks are present nearly everywhere in Illinois, Mesozoic and most Cenozoic rocks are absent from the stratigraphic record of virtually all parts of the state. In the field trip region, except for the glacial deposits, no rocks younger than the Ordovician Period are present. Therefore, the tectonic history (the history of the Earth's crustal movements) of the region during the past 440 million years is only partially known and must be inferred from evidence in other places.

A minor unconformity separates the Cambrian (Croixan) and Lower Ordovician (Canadian) rocks in northern Illinois. This indicates that there was probably a brief period (perhaps a few million years) when the Cambrian rocks were exposed at the land surface, either because the sea level fell, or because the sea floor in the area was uplifted slightly, or because of a combination of the two. After the Lower Ordovician sediments of the Prairie du Chien Group were deposited, tectonic (vertical or tilting) movements that disturbed major areas in the eastern part of the continent also caused uplift, warping, faulting, and erosion here. Faulting with at least 235 feet of displacement occurred here before the St. Peter Sandstone was deposited. Throughout the remainder of the Ordovician Period there appears to have been relatively little tectonic activity throughout Illinois. We know there were post-Ordovician tectonic events because the Ordovician and older rocks in the area are broken by faults and warped by folds.

During Late Mississippian and Early Pennsylvanian time, what is now the east coast of the North American continent was colliding with another continent, creating the Appalachian Mountains. Several major structural features formed in Illinois at this time, including 1) the La Salle Anticlinal Belt that extends from La Salle County to around Lawrence County; 2) the Cap Au Grès faulted flexure that crosses the southern tip of Calhoun County and disturbs the rocks in Pere Marquette State Park; and 3) the initial movements on the Mississippi River Arch. During this time, northern Illinois also was apparently uplifted, faulted, and warped. The major faulting activity on the Sandwich Fault Zone, therefore, is likely to be related to this major tectonic disturbance.

There is no evidence that the faults in the field trip area have been active for hundreds of thousands of years. The glacial sediments are neither warped by folds nor broken by fault movements. There is no evidence that any younger sediments accumulated during the long time interval between the deposition of the latest Pennsylvanian rocks and the deposition of the Pleistocene glacial drift. This "sub-Pleistocene unconformity," the bedrock surface in Illinois, truncates all the Tertiary, Cretaceous, and Paleozoic rocks down to the Upper Cambrian rocks exposed at the bedrock surface in the Sandwich Fault Zone here.

Physiography Physiography is the study and classification of the surface features of the Earth on the basis of similarities in geologic structure and the history of geologic changes. The physiographic contrasts between various parts of Illinois are due to a number of factors, including the topography of the bedrock surface, the extent of the various glaciations, differences in the thickness of the glacial deposits, differences in age of the uppermost glacial drift, and the effects of erosion on the land surface.

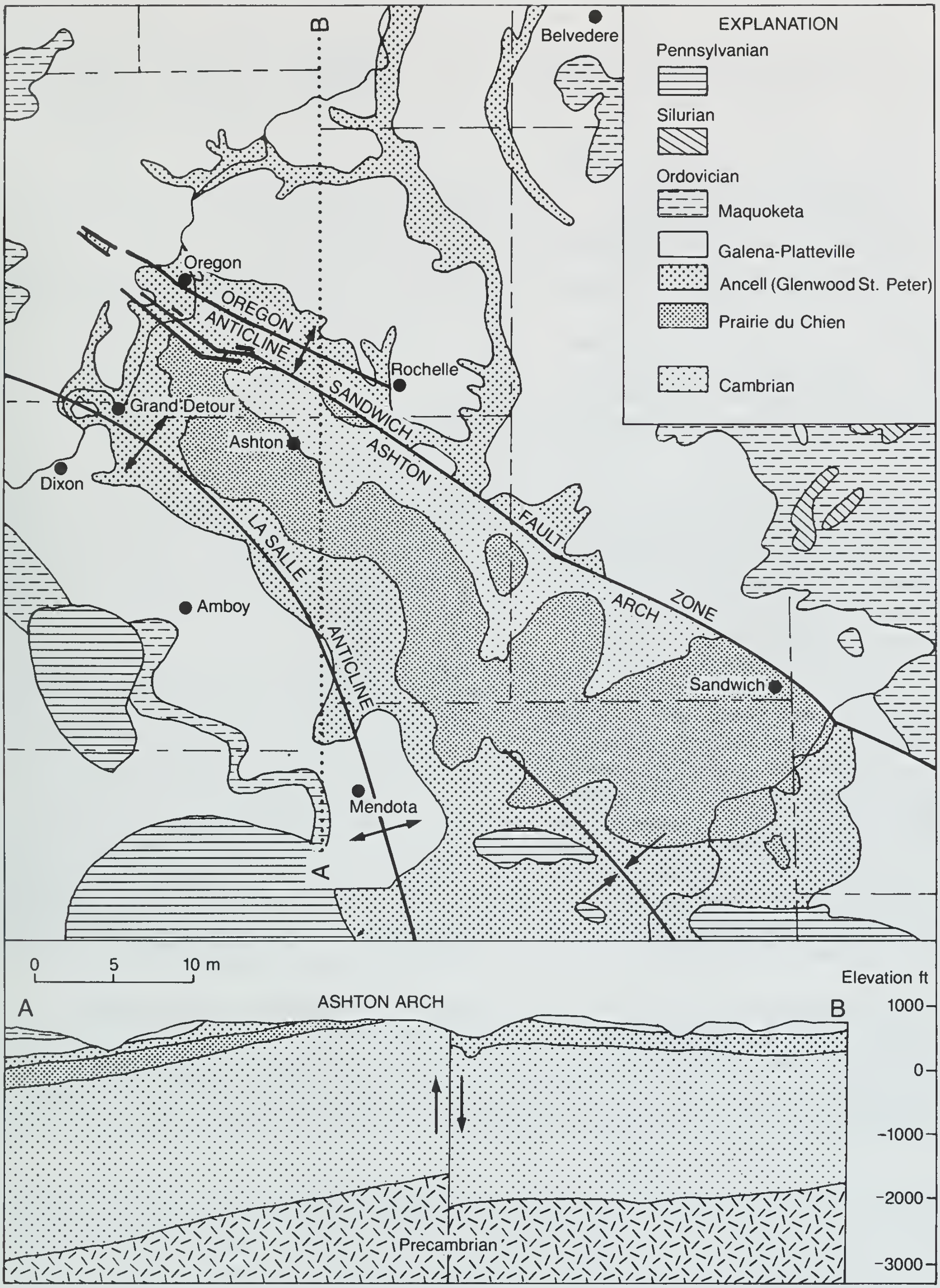


Figure 7 Generalized geologic map of north-central Illinois. Cross section along line A-B crosses the Ashton Arch and the Sandwich Fault Zone.

The Oregon field trip area is situated in the northern Illinois part of the Till Plains Section, the division of the Central Lowland Province (fig. 8) that embraces about four-fifths of Illinois. This section is characterized by broad till plains which are relatively uneroded (a youthful stage of erosion), in contrast to the maturely eroded Dissected Till Plains on older drift-sheets to the west. In Illinois, the Section has seven subdivisions: the Bloomington Ridged Plain, Galesburg Plain, Green River Lowland, Kankakee Plain, Mt. Vernon Hill Country, Rock River Hill Country, and the Springfield Plain.

Oregon is located in the east-central part of the Rock River Hill Country. Leighton and others (1948) describe the Rock River Hill Country as an area of subdued rolling hill-lands in the stage of late youth to early maturity. In other words, there are still upland tracts that do not have well-developed stream networks to drain them. Near the larger streams little of the flat upland surface remains. The area is mostly in slopes with the beginnings of floodplain development along the stream valleys. This area includes the eroded Illinoian till plain north of the Wisconsinan Shelbyville Moraine and Meredosia Valley and a fringe of Wisconsinan drift that lies west of Marengo Ridge.

Figure 8 Physiographic divisions of Illinois.

The Illinoian drift is thin throughout most of the area and is not known to be underlain by older tills. Thus the major uplands and valleys are determined primarily by the bedrock surface. The Illinoian drift is without marked ridging, and constructional forms (such as low kames, which are small hills of sand and gravel) are very localized.

The major streams flow radially from a central upland into the Mississippi River on the west and the Rock River on the east and south. Their valleys are relatively broad and steep walled and have terrace remnants of alluvial fill. The Mississippi River and the upper part of the Rock River occupy large alluviated valleys. Below the mouth of the Kishwaukee River, the Rock has cut a post-Illinoian rock gorge that extends south to the Green River Lowland. Numerous smaller rock gorges also are present along tributaries. Locally, these gorges are superimposed on spurs of the bedrock upland. Most of the minor streams are narrow and V-shaped in cross section.

Drainage Oregon is located at the southern end of one of the larger bedrock gorges along the Rock River. The larger Rock River tributaries in this area southward from the Kishwaukee River and Stillman Creek include Leaf River, Spring, Silver, Coon, Mud, Gale, and Haney Creeks, and Kyte River. Pine Creek drains the area immediately to the west along its southward course to the Rock just west of Grand Detour.

Relief The highest land surface along the Oregon field trip, slightly more than 915 feet mean sea level (m.s.l.), occurs at mile 11.55 on the field trip route. The lowest elevation is slightly less than 656 feet m.s.l. and is the surface elevation of Rock River in the vicinity of Castle Rock State Park. Thus the maximum relief along the field trip route is 274 feet. The maximum local relief is slightly more than 134 feet from the top of the bluff to the Rock River at Lowden State Park where the statue of the American Indian stands.

Mineral Resources

Groundwater Groundwater is a mineral resource frequently overlooked in assessing an area's natural resource potential. The availability of this mineral resource can be essential for orderly economic and community development. More than 48 percent of the state's 11 million citizens depend on groundwater for their water supply. Groundwater is derived from underground formations called aquifers. An aquifer is a body of rock that contains enough water-bearing porous and permeable materials to release usable quantities of water into an open well or spring. The water-yielding capacity of an aquifer can only be evaluated by constructing wells into it. After construction, the wells are pumped to determine the quality and quantity of groundwater available for use.

Northern Illinois is underlain by three major aquifer systems that are differentiated from one another on the basis of their hydrogeologic properties and the source of recharge (fig. 9). The aquifer systems are 1) Non-Indurated Rock Aquisystem, consisting of the Prairie Aquigroup: local and intermediate flow systems in alluvium, glacial drift, or other deposits; 2) Indurated Rock Aquisystem, divided into (a) Upper Bedrock Aquigroup: local and intermediate flow systems with connection to the Prairie Aquigroup, (b) Mississippi Valley Bedrock Aquigroup, (c) Midwest Bedrock Aquigroup: intermediate and regional flow systems whose top is the top of the Ordovician Maquoketa Shale Group or other confining units and whose bottom is at the top of the Cambrian Eau Claire Formation or stratigraphically higher, and (d) Basal Bedrock Aquigroup: intermediate and regional flow systems below the shale units of the Eau Claire Formation and above the crystalline basement rocks; and 3) Crystalline Rock Aquisystem, in which there are no significant aquifers in Illinois.

The glacial drift or Prairie Aquigroup overlying bedrock is recharged by local precipitation and thus is susceptible to surface contamination. The Midwest Bedrock Aquigroup is important to the area as this aquifer group consists generally of those bedrock formations that directly underlie the glacial drift. In this area, these formations consist mostly of Ordovician dolomites that are themselves relatively nonporous but which contain water in open joints and fractures. These rocks also are recharged by local precipitation. The only filtering of the recharge water is by the overlying glacial deposits. Where the glacial units are quite thin or absent and the bedrock is exposed at the surface, recharge is directly into the rock units, and there is little, if any, filtering of deleterious materials.

The deep bedrock aquifer groups are made up mostly of relatively porous sandstones. They receive most of their recharge from regions where they are exposed at the surface or where they directly underlie the glacial drift, miles to the north of the field trip area. The water in the

SYSTEM	SERIES AND MEGAGROUP	GROUP AND FORMATION	HYDROSTRATIGRAPHIC UNITS Aquigroup	HYDROSTRATIGRAPHIC UNITS aquifer/aquitard	LOG	THICKNESS (ft)	DESCRIPTION
Quaternary	Pleistocene	Undifferentiated	Prairie	Pleistocene		0 – 600	Unconsolidated glacial deposits – pebbly clay (till) silt, and gravel Loess (windblown silt), and alluvial silts, sands and gravels.
Tertiary & Cretaceous		Undifferentiated	Prairie			0 – 100	Sand and silt.
Carboniferous: Pennsylvanian		Undifferentiated	Upper Bedrock: Mississippi Valley	Pennsylvanian		0 – 500	Mainly shale with thin sandstone, limestone and coal beds
Carboniferous: Mississippian	Valmeyeran	St. Louis Ls Salem Ls Warsaw Ls Keokuk Ls Burlington Ls	Upper Bedrock: Mississippi Valley	St. Louis - Salem aquifer Keokuk – Burlington aquifer		0 – 600	Limestone, cherty limestone, green, brown and black shale, silty dolomite.
Carboniferous: Mississippian	Kinderhookian	Undifferentiated	Upper Bedrock: Mississippi Valley				
Devonian		Undifferentiated	Upper Bedrock: Mississippi Valley	Devonian		0 – 400	Shale, calcareous, limestone beds, thin
Silurian	Niagaran	Port Byron Fm Racine Fm Waukesha Ls Joliet Ls	Upper Bedrock: Mississippi Valley	Silurian dolomite aquifer		0 – 465	Dolomite, silty at base, locally cherty
Silurian	Alexandrian	Kankakee Ls Edgewood Ls	Upper Bedrock: Mississippi Valley	Silurian dolomite aquifer			
Ordovician	Cincinnatian	Maquoketa Shale Group	Upper Bedrock; Midwest Bedrock	Maquoketa confining unit		0 – 250	Shale, gray or brown, locally dolomite and/or limestone, argillaceous.
Ordovician	Mohawkian (Ottawa Ls Megagroup)	Galena Group Decorah Subgroup Platteville Group	Upper Bedrock; Midwest Bedrock	Galena-Platteville unit		0 – 450	Dolomite and/or limestone, cherty Dolomite, shale partings, speckled. Dolomite and/or limestone, cherty, sandy at base.
Ordovician	Mohawkian; Chazyan (Ancell Gr)	Glenwood Fm St Peter Ss	Upper Bedrock; Midwest Bedrock	Ancell aquifer		100 – 650	Sandstone, fine- and coarse-grained, little dolomite; shale at top. Sandstone, fine- to medium-grained, locally cherty red shale at base.
Ordovician	Canadian (Knox Megagroup; Prairie du Chien Group)	Shakopee Dol New Richmond Ss Oneota Dol Gunter Ss	Midwest Bedrock	Middle confining unit: Prairie du Chien		100 – 1300	Dolomite, sandy, cherty (oolitic), sandstone. Sandstone, interbedded with dolomite. Dolomite, white to pink, coarse-grained, cherty (oolitic), sandy at base
Cambrian	St Croixian (Knox Megagroup)	Jordan Ss Eminence Fm - Potosi Dolomite	Midwest Bedrock	Middle confining unit: Eminence-Potosi			Dolomite, white, fine-grained, geodic quartz, sandy at base.
Cambrian	St Croixian (Knox Megagroup)	Franconia Fm	Midwest Bedrock	Middle confining unit: Franconia			Dolomite, sandstone, and shale, glauconitic, green to red, micaceous
Cambrian	St Croixian	Ironton Ss Galesville Ss	Midwest Bedrock	Ironton-Galesville aquifer		0 – 270	Sandstone, fine- to medium-grained, well sorted, upper part dolomitic.
Cambrian	St Croixian	Eau Claire Fm	Basal Bedrock	Eau Claire		0 – 450	Shale and siltstone, dolomite, glauconitic, sandstone, dolomitic, glauconitic
Cambrian	St Croixian	Mt Simon Fm	Basal Bedrock	Elmhurst-Mt Simon aquifer		0 – 2600	Sandstone, coarse-grained, white, red in lower half, lenses of shale and siltstone, red, micaceous
Pre Cambrian			Crystalline				No aquifers in Illinois

Note: The rock stratigraphic and hydrostratigraphic unit classifications follow the usage of the Illinois State Geological Survey

Figure 9 Stratigraphy and water-yielding properties of the rocks and character of the groundwater in the study area.

DRILLING AND CASING CONDITIONS	WATER-YIELDING PROPERTIES	CHEMICAL QUALITY OF WATER	WATER TEMPERATURE °F
Boulders, heaving sand locally; sand and gravel wells usually require screens and development; casing in wells into bedrock.	Sand and gravel, permeable. Locally, wells yield as much as 3000 gpm. Specific capacities vary from about 0.1 to 5600 gpm/ft.	TDS generally between 400 and 600 mg/L. Hardness 300–400 mg/L. Iron generally 1–5 mg/L.	50 – 64
Shale requires casing.	Extremely variable. Sandstone and limestone units generally yield less than 10 gpm.	TDS extremely variable regionally and with depth. North-central Illinois, 500–1500 mg/L; southern, 500–3000 mg/L. Hardness: 150–400 mg/L north; 150–1000 mg/L south. Iron generally 1–5 mg/L.	53 – 57
	In southern two-thirds of state yields generally less than 25 gpm.	TDS ranges between 400 and 1000 mg/L. Hardness is generally between 200 and 400 mg/L. Iron: 0.3–1.0 mg/L.	53 – 59
Upper part usually weathered and broken; crevicing varies widely.	Yields inconsistent. Major aquifer in NE and NW Illinois. Yields in fractured zones more than 1000 gpm.	TDS: 350–1000 mg/L; Hardness: 200–400 mg/L; Iron: 0.3–1.0 mg/L.	52 – 54
Shale requires casing.	Shales generally not water yielding. Crevices in dolomite units yield small local supplies.		
Crevicing commonly where formations underlie drift. Top of Galena usually selected for hole reduction and seating of casing.	Where overlain by shales, crevicing and well yields small. Where overlain by drift wells yield moderate quantities of water.	For Midwest Bedrock Aquigroup as a whole, TDS ranges from 400 to 1400 mg/L in NW and up to 2000 mg/L in south. Hardness ranges from 175 mg/L in northern recharge areas to 600 mg/L in E. Cook and S. Fulton Counties. Iron generally less than 1.0 mg/L.	52 – 73
Lower cherty shales cave and are usually cased. Friable sand may slough.	Small to moderate quantities of water. Transmissivity approximately 15 percent of that of the Midwest Bedrock Aquigroup.		
Crevices encountered locally in the dolomite, especially in the Eminence-Potosi. Casing not required.	Crevices in dolomite and sandstone yield small to moderate quantities of water. Transmissivity approximately 35 percent of that of the Midwest Bedrock Aquigroup.		
Amount of cementation variable. Lower part more friable. Sometimes sloughs.	Most productive unit of the Midwest Bedrock Aquigroup. Yields over 500 gpm common in northern Illinois. Transmissivity approximately 50 percent of that of the Midwest Bedrock Aquigroup.		
Casing not usually necessary. Locally weak shales may require casing.	Shales generally not water yielding.		
Casing not required.	Moderate quantities of water in upper units. Comparable in permeability to the Glenwood-St. Peter Sandstone.	Varies northwest to southeast and with depth. At shallower depths, TDS: 235–4000 mg/L, Hardness: 220–800 mg/L, Iron: 0.1–20 mg/L. High chloride concentrations with depth.	51 – 62 in the north 80 or more in the south

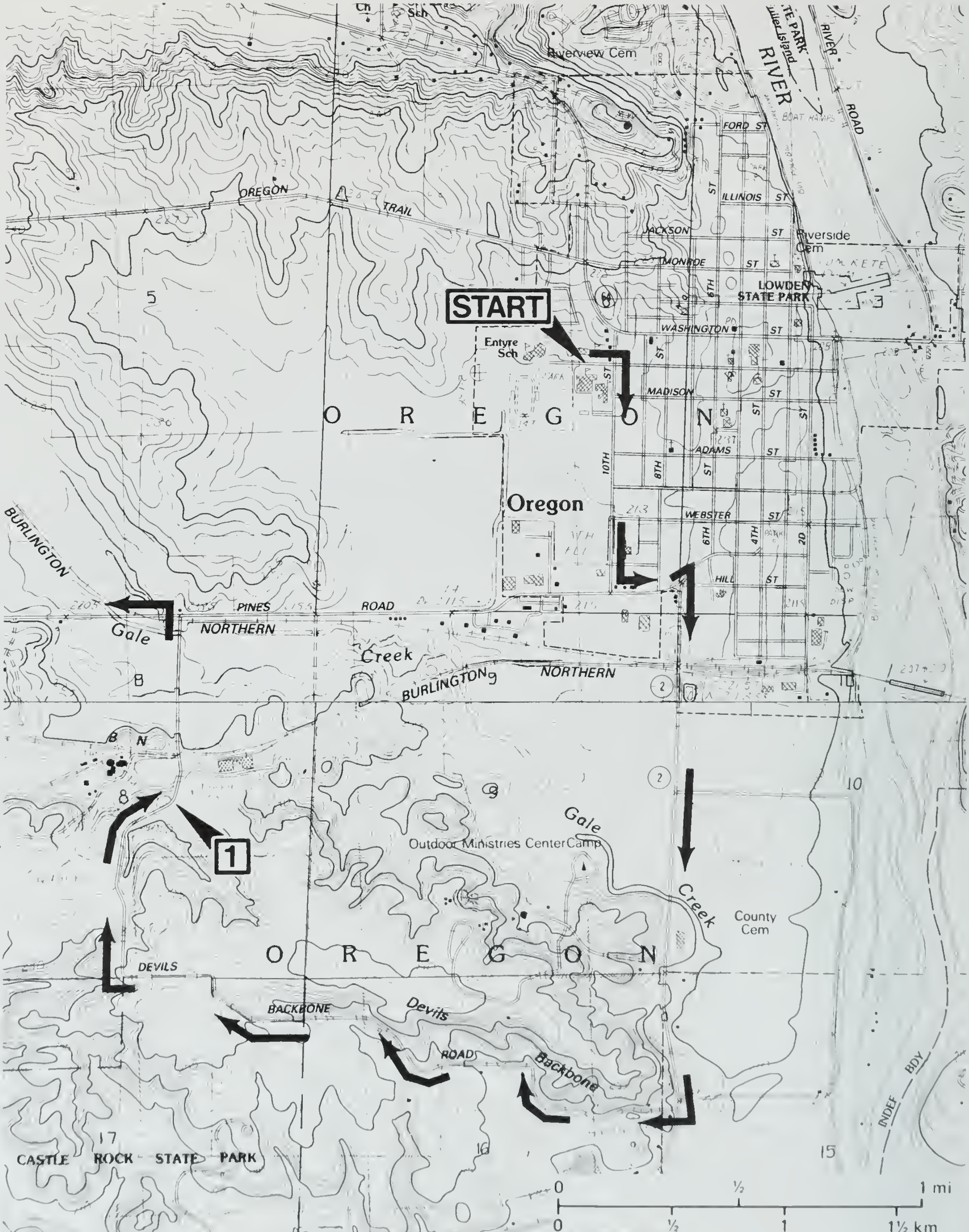
deep bedrock groups has been in contact with the rocks that make up the aquifer for a relatively long time and has had plenty of time to dissolve some of the minerals in those rocks. Consequently, the water in the deep bedrock aquifer groups generally has a fairly high content of dissolved solids.

Mineral Production Of the 102 counties in Illinois, 99 reported mineral production during 1988, the last year for which totals are available. Total value of all minerals extracted, processed, and manufactured in Illinois was $2.8 billion (Samson and Bhagwat, in press).

Ogle County ranked 40th among Illinois counties reporting mineral production during 1988. Industrial sand and stone were the primary minerals extracted in order of value. Illinois ranks first of 38 producing states in industrial sand production. The state accounted for 15.2 percent (4.3 million tons) of the U.S. total. Five companies operate eight pits in La Salle, Mason, and Ogle Counties. The average unit value was $12.97 per ton. Industrial sand is used in glass manufacturing and for molding, sand blasting, griding and polishing, and other uses.

Total Illinois stone production was estimated at 57.9 million tons in 1988. Stone is used primarily for construction aggregate, especially as road-base stone, but also for chemical, agricultural, and other purposes. Illinois' tonnage ranked seventh among 49 states reporting production of crushed and broken stone. A little more than 44 percent of Illinois' total production of crushed and broken stone came from just 11 quarries, primarily in the Chicago metropolitan region.

FIELD TRIP NOTES


START
1
Riverview Cem
RIVER
ROAD
BOAT RAMPS
FORD ST
ILLINOIS ST
JACKSON ST
MONROE ST
Riverside Cem
LOWDEN STATE PARK
WASHINGTON ST
Entyre Sch
MADISON ST
ADAMS ST
WEBSTER ST
HILL ST
10TH
8TH
6TH
4TH
2D
OREGON TRAIL
O R E G O N
Oregon
BURLINGTON
PINES ROAD
NORTHERN
Gale Creek
BURLINGTON NORTHERN
Outdoor Ministries CenterCamp
County Cem
DEVILS BACKBONE ROAD
Devils Backbone
CASTLE ROCK STATE PARK
INDEF BDY
0 ½ 1 mi
0 ½ 1 1½ km

GUIDE TO THE ROUTE

Miles next point	Miles from starting point	
0.0	0.0	Line up on the north side of Oregon High School on Jefferson Street (N line SE NE SW NE Sec. 4, T23N, R10E, 4th P.M., Ogle County, Oregon 7.5-minute Quadrangle [42089A3]).[1]
0.0	0.0	Intersection of Jefferson Street and south 10th Street. STOP: 4-way. TURN RIGHT (south) on 10th Street.
0.2+	0.2+	STOP: (3-way) at T-intersection with Adams Street. CONTINUE AHEAD.
0.15+	0.4+	STOP: (3-way) at T-intersection with Webster Street. CONTINUE AHEAD (south).
0.2+	0.6+	STOP: (1-way) at T-intersection with Pines Road. TURN LEFT (east).
0.15+	0.8+	BEAR RIGHT (southerly) at Y-intersection and STOP (1-way). TURN RIGHT (south) on State Route (SR) 2.
0.2	1.0+	CAUTION: there is a good view of the "Oregon basin" on both sides as you cross the Burlington Northern (BN) Railroad overpass.
0.6+	1.65+	Cross Gale Creek.
0.3	1.95+	Cross Gale Creek.
0.1+	2.05+	Cross Gale Creek and prepare to turn right.
0.15+	2.2+	TURN RIGHT (west) on Devils Backbone Road and ascend hill. This westward-trending ridge of St. Peter Sandstone is capped by Glenwood strata and Pecatonica dolomite. It forms the south wall of the Oregon basin west of Rock River and has a summit elevation in excess of 900 feet, indicating that it is a remnant of the old erosion surface, the Lancaster Peneplain. CAUTION: Devils Backbone Road has limited visibility because of many curves, dips and rises in the road, and dense vegetation.

Slightly more than 0.05 mile south from this T-road intersection is an abandoned quarry in the Middle Ordovician St. Peter Sandstone. The sandstone was trucked to the silica plant next to STOP 2. About 0.8 mile south of this same T-road intersection is the area where the Sandwich Fault Zone crosses to the east side of Rock River. Surface slump and vegetation make it

1 The number in brackets [42089A3] after the topographic map name is the code assigned to that map as part of the National Mapping Program. The state is divided into 1° blocks of latitude and longitude. The first two numbers refer to the latitude of the southeast corner of the block; the next three numbers designate the longitude. The blocks are divided into 64 7.5-minute quadrangles; the letter refers to the east-west row from the bottom, and the last digit refers to the north-south column from the right.

difficult to see the various faulted units here. The entrance to Castle Rock State Park is 1.1 miles south on SR 2 from Devils Backbone Road; Castle Rock, a well known St. Peter Sandstone promontory on the west bank of Rock River lies about 1.35 miles south of the park entrance.

2.15	4.35+	Note stockpiles of disaggregated white sand to the left and the Unimin Corporation processing plant ahead and in the background.
0.2	4.55+	Park along the right side and as far off the road as you safely can. CAUTION: Visibility is somewhat restricted here. Do NOT climb and/or cross the fence lines here.

STOP 1 View and study the exposure of the Middle Ordovician St. Peter Sandstone on the right (east) side of the road. Part of the exposure is beyond the fence (SW SE SW NE Sec. 8, T23N, R10E, 4th P.M., Ogle County, Daysville 7.5-minute Quadrangle [41089H3]).

The St. Peter Sandstone is of special interest geologically because of its widespread distribution and its remarkably high purity. The St. Peter occurs throughout a vast area across the Midwest, stretching from northern Michigan to Kentucky and from Kansas to Ohio. Principal areas of exposure in Illinois are in the Dixon-Oregon area and the Ottawa-Wedron-La Salle area, where the Middle Ordovician rocks are brought to the bedrock surface along the flanks of the Oregon Anticline and the Ashton Arch and the La Salle Anticlinal Arch, respectively. The St. Peter forms the high bluffs along the Illinois River at Starved Rock and Buffalo Rock State Parks. Outside of these areas, the St. Peter has been penetrated in the subsurface by many wells. Except locally, where it has been removed by erosion, the formation underlies almost the entire state.

The St. Peter Sandstone is a fine-grained sandstone consisting almost entirely of well-rounded grains of the mineral quartz. Many of the grains exhibit a peculiar frosted or dull appearance. The sandstone also exhibits well-developed inclined laminations called cross bedding. On many exposures the sandstone is light gray to pure white, giving the formation a distinctive appearance, but commonly it is slightly brownish in color because of staining by iron oxide. The sandstone typically exhibits a sugary texture and is friable (loosely held together; easily disaggregated in the hand). In the subsurface, the St. Peter is sometimes tightly cemented by calcium carbonate ($CaCO_3$), suggesting that where it is friable, a pre-existing cement has been removed through weathering and through leaching by percolating groundwater.

The origin of the St. Peter Sandstone has interested geologists for a long time. An early theory suggested that the sandstone was deposited on the land in a vast interior desert of drifting sand dunes. Similar cross bedding, roundness, and frosting are found in sands of present-day deserts, such as the Great Sahara Desert of North Africa. The rounding and frosting is caused by the grains striking each other as they were blown by the wind. Today, most geologists believe that the St. Peter is a marine deposit. All of the characteristics of the sandstone can be explained as the products of wave and current action in a shallow sea. Beds of marine limestone are present in the middle and upper parts of the formation in extreme northern and southwestern Illinois, Iowa, Arkansas, and Oklahoma. Marine fossils occur in some of the limestone beds and, although extremely rare, in the sandstone. The sand was derived principally from Precambrian igneous and metamorphic rocks in south-central Canada and transported southward by streams into the Middle Ordovician sea. Conditions in the sea remained stable for a long time, and the sands were extensively reworked by waves and currents that wore away the grains of less resistant minerals and winnowed out the muddy

sediments, leaving behind the well-sorted, well-rounded, highly resistant quartz sand. As the quartz grains were moved along the sea bottom by currents and washed back and forth by waves, they gradually became rounded and frosted. The cross bedding in the St. Peter Sandstone indicates a high-energy, agitated environment, but it more strongly resembles cross bedding exhibited by known marine sandstones than that found in dune sands. Some shifting of the St. Peter sands probably occurred in beach dunes along the shoreline of the St. Peter sea, similar to shifting found along present-day shorelines. These dune sands were later eroded and incorporated into the marine deposits as the sea advanced toward the north.

The contact between the St. Peter Sandstone and the older sedimentary rocks upon which it rests is a major unconformity or erosion surface throughout the Midwest. After deposition of the Lower Ordovician strata, crustal movements raised the Midcontinent region above sea level, and a long time interval of erosion accompanied by widespread development of solution features (karst topography), cut deeply into the underlying rocks. There is evidence that a river system drained across northern Illinois from the northeast and cut deep channels into the bedrock. All of the Shakopee and New Richmond Formations and much of the Oneota Dolomite were stripped off the crest of the Ashton Arch (figs. 2 and 7). Erosion also cut into the Cambrian rocks. North of the Ashton Arch, in northern Illinois and southern Wisconsin, the Lower Ordovician strata were completely removed from the flanks of the Wisconsin Arch in many places. The erosion interval ended when the Midcontinent region was lowered below sea level again.

When the Middle Ordovician sea advanced across the Midcontinent region, the clean, well-sorted St. Peter Sandstone was deposited on the erosional surface of Lower Ordovician and Cambrian rocks (figs. 2 and 7). The St. Peter is generally less than 200 feet thick, but where the sand filled ancient river channels, it is locally as much as 500 feet thick. Survey geologist T.C. Buschbach (1964) presented evidence that some of the unusually thick sandstone bodies were deposited in large sinkholes rather than in river channels. The sinkholes were formed when percolating groundwater dissolved some of the Lower Ordovician limestones during the pre-St. Peter erosion interval.

The St. Peter Sandstone is a valuable source of silica sand to Illinois and to the nation. It is world famous as a glass sand, but it also is used as molding sand (foundry sand) and abrasives; in the manufacture of silica brick, ceramic glazes, and ferro-silicon; and for a score of other uses. The oil industry uses the sand in the fracture treatment of oil-bearing formations to increase the flow of oil through the rocks. In 1987, Illinois' production accounted for 15.4 percent of the U.S. total. About 45 percent of the sand produced in Illinois was used in glassmaking, and 27 percent was used as foundry sand.

The St. Peter Sandstone mined at the Unimin Corporation operation to the left (west) of the road contains the clay minerals kaolinite and illite finely dispersed throughout the rock. Survey scientists have sampled the sandstone here in order to separate and identify the clay minerals involved and to see if it might be economically feasible to concentrate the clays to make a marketable product from an otherwise waste material.

0.0	4.55+	Leave Stop 1. CONTINUE AHEAD (north) down the hill.
0.05+	4.65+	CAUTION: Entrances to Unimin Corporation plant to left and Acme Resins to the right. Just beyond the entrances is a guarded double-track BN grade crossing.

0.3+	5.0+	Cross Gale Creek.
0.05-	5.05+	CAUTION: unguarded single-track BN grade crossing with STOP (1-way) just beyond at T-intersection. Do NOT stop on tracks. TURN LEFT (west) on Pines Road.
0.1	5.15+	CAUTION - unguarded single-track BN grade crossing.
0.05+	5.25	Cross Gale Creek.
0.9	6.15	Prepare to turn left.
0.1+	6.25+	TURN LEFT (south) on T-road (Burlington). CAUTION: this is a narrow gravel road.
0.2	6.45+	Prepare to park ahead.
0.05	6.5+	PARK along the roadside BEFORE crossing the one-lane wooden bridge across the BN Railroad tracks. Do NOT block the bridge or field entrances. USE EXTREME CAUTION in this area. With binoculars you can view the railroad cut from the wooden bridge or the approaches on both sides (somewhat difficult to do when the foliage is present). It is NOT prudent for you to get down to track level to view this cut. The walls of the cut are steep, crumbly, and very dangerous; in addition, this is the private property of the Burlington Northern Railroad. The cut contains the mainline between the Twin Cities and Chicago and trains are fast-moving and frequent.

STOP 2 View of part of the faulted and disturbed Middle Ordovician rocks in the Sandwich Fault Zone that has been exposed in the southwest to northeast BN Railroad cut (the bridge angles approximately across the Center W line NW NW SE Sec. 7, T23N, R10E, 4th P.M., Ogle County, Grand Detour 7.5-minute Quadrangle [41089H4]).

Here we have the opportunity to see part of the Sandwich Fault Zone near its northwestern terminus. According to Survey geologists Kolata, Buschbach, and Treworgy (1978), who reported on a study of this structure, this is one of the longest fault zones in Illinois, extending southeastward from here for nearly 85 miles to near Manhattan, Will County, about 9 miles southeast of Joliet (fig. 10). Because of the map scales generally used, the Sandwich Fault Zone usually is shown as a single fault, when in fact it is a faulted zone, usually from 1/2 to 2 miles wide, consisting of high-angle faults with displacements of a few inches to as much as several hundred feet. The total cumulative displacement is highest, 800 feet, at its midpoint at Sandwich, De Kalb County, about 40 miles to the southeast. Throughout most of its extent, the fault zone is upthrown to the south and where seen in outcrop or interpreted from closely-spaced drilling, the fault zone is characterized by high-angle faults that commonly bound grabens and horsts (fig.11). Normal and reverse faults have also been reported from this area.

Only a few of the individual faults are visible because of the subdued topography along the fault and the glacial drift cover over the bedrock. The fault zone is well defined, however, by the areal distribution of lower Paleozoic strata. On the south side of the fault zone, the upthrown block brings the Cambrian Franconia Formation, the oldest Illinois bedrock exposed, to the

Barnett Memorial Airport
36
31
32
64
ROAD
RIDGE
LIMB
KILN
T24N
T23N
BURLINGTON
NORTHERN
OREGON
TRAIL
OREGO
6
5
OREGON
ROAD
RIDGE
BURLINGTON
St Marys Cem
PINES
NORTHERN
Gale
PINES ROAD
R9E
R10E
12
8
PINES
BURLINGTON
NORTHERN
Mt Zion Cem
2
0
½
1 mi
0
½
1
1½ km

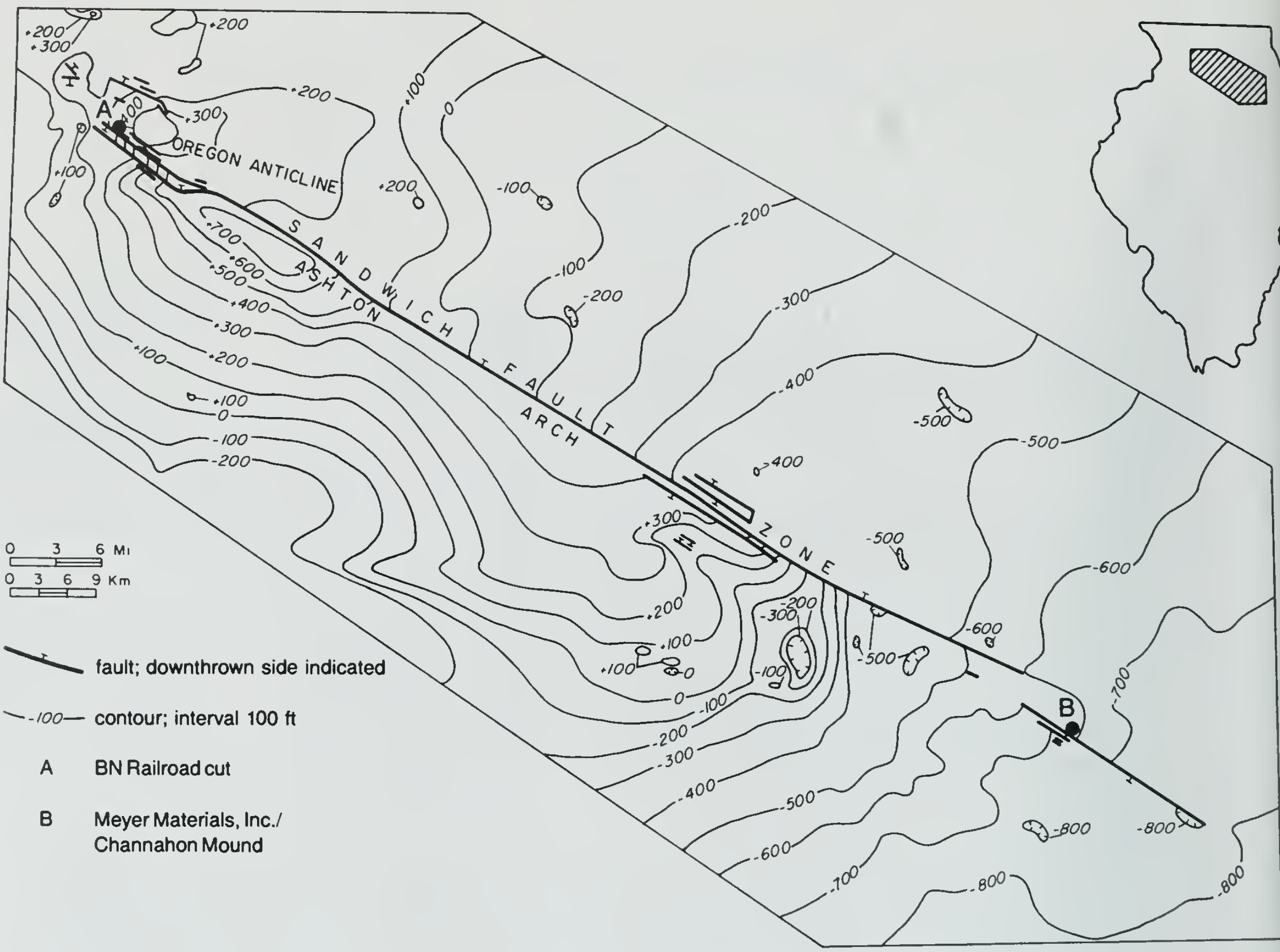


Figure 10 Structure of the top of the Franconia Formation along the Sandwich Fault Zone; datum sea level.

bedrock surface (figs. 3 and 6). Outcrops showing the fault zone are mainly limited to the areas at both ends of the fault zone.

Throughout much of southern Ogle County surface deposits are relatively thin, and bedrock exposures are fairly common. High-angle faults, generally trending northwest, have displacements ranging from a few inches (fig. 12) to several hundred feet. The structure is complex, and individual faults are very difficult to trace from one exposure to another. Figure 13 shows the locations within the railroad cut of the various stratigraphic units and the associated faults.

0.0	6.5	Leave Stop 2. TURN AROUND and retrace route to the north.
0.25	6.75+	STOP: 1-way. CAUTION: visibility somewhat limited. TURN LEFT (southwesterly) on Pines Road.

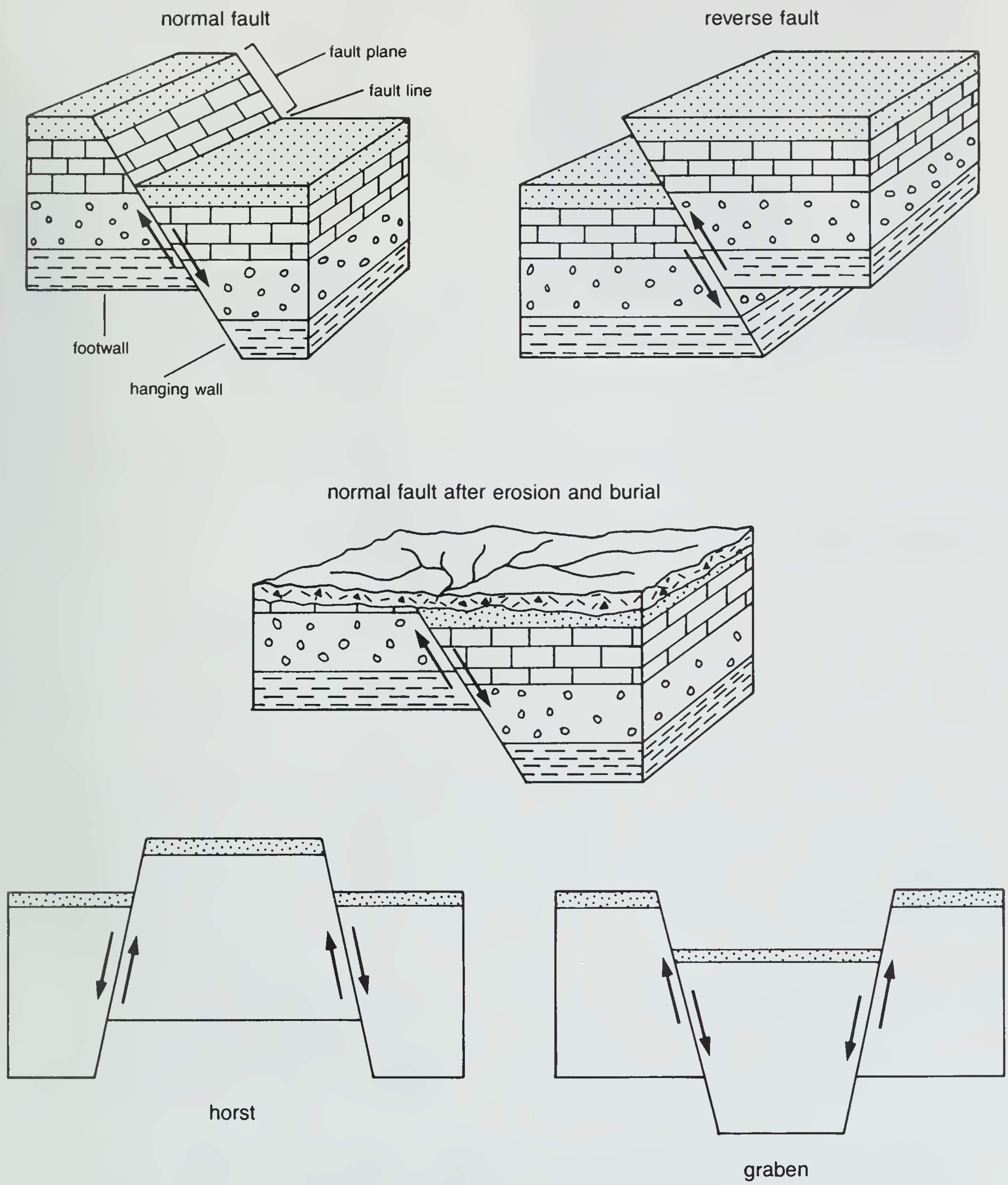


Figure 11 Diagrammatic illustrations of fault types that may be present in the field trip area (arrows indicate relative directions of movement on each side of the fault).

Figure 12 Small fault in the New Richmond Sandstone in an outcrop in the Sandwich Fault Zone south of Oregon (SE NE SW Sec. 16, T. 23 N., R. 10 E.).

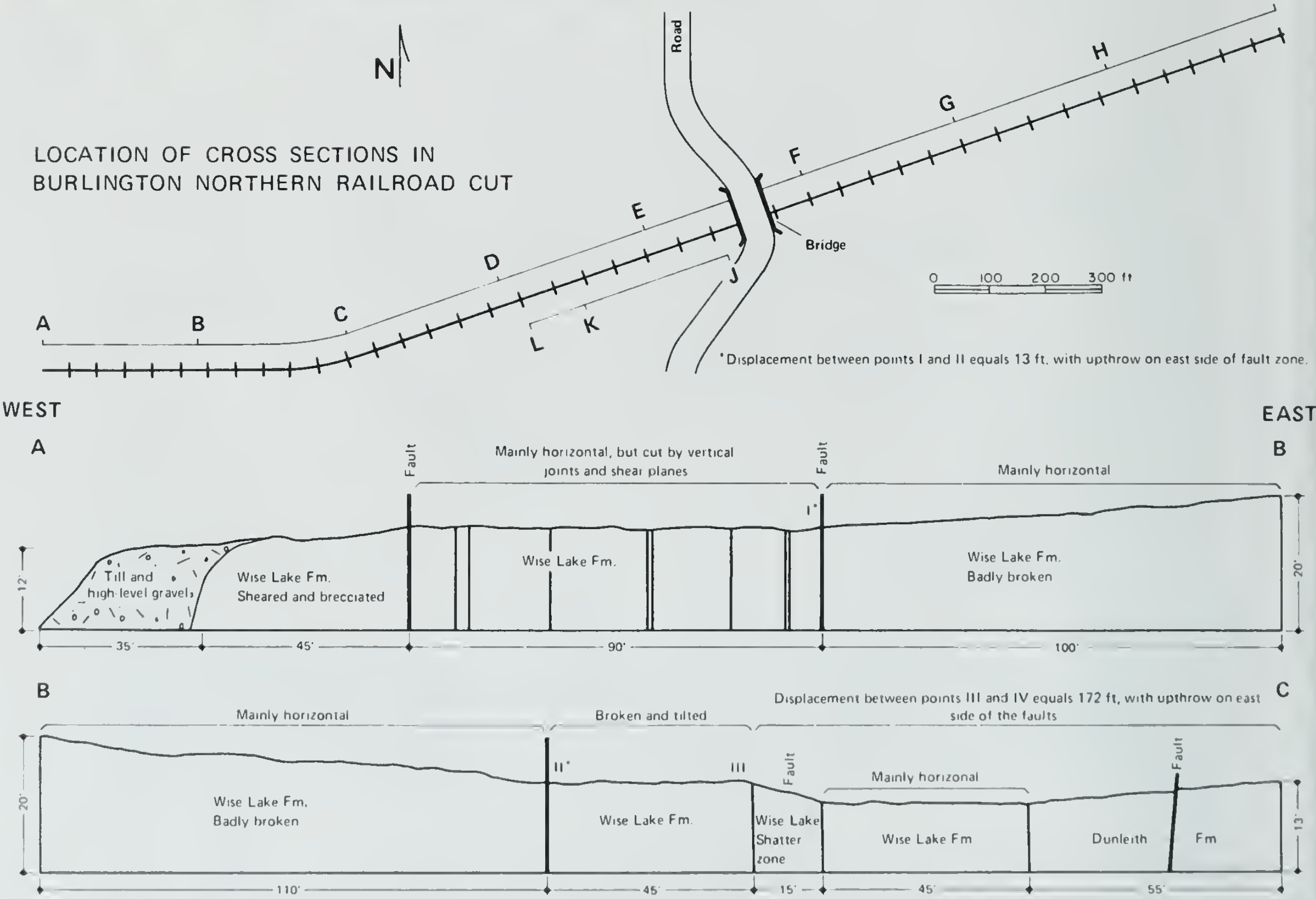
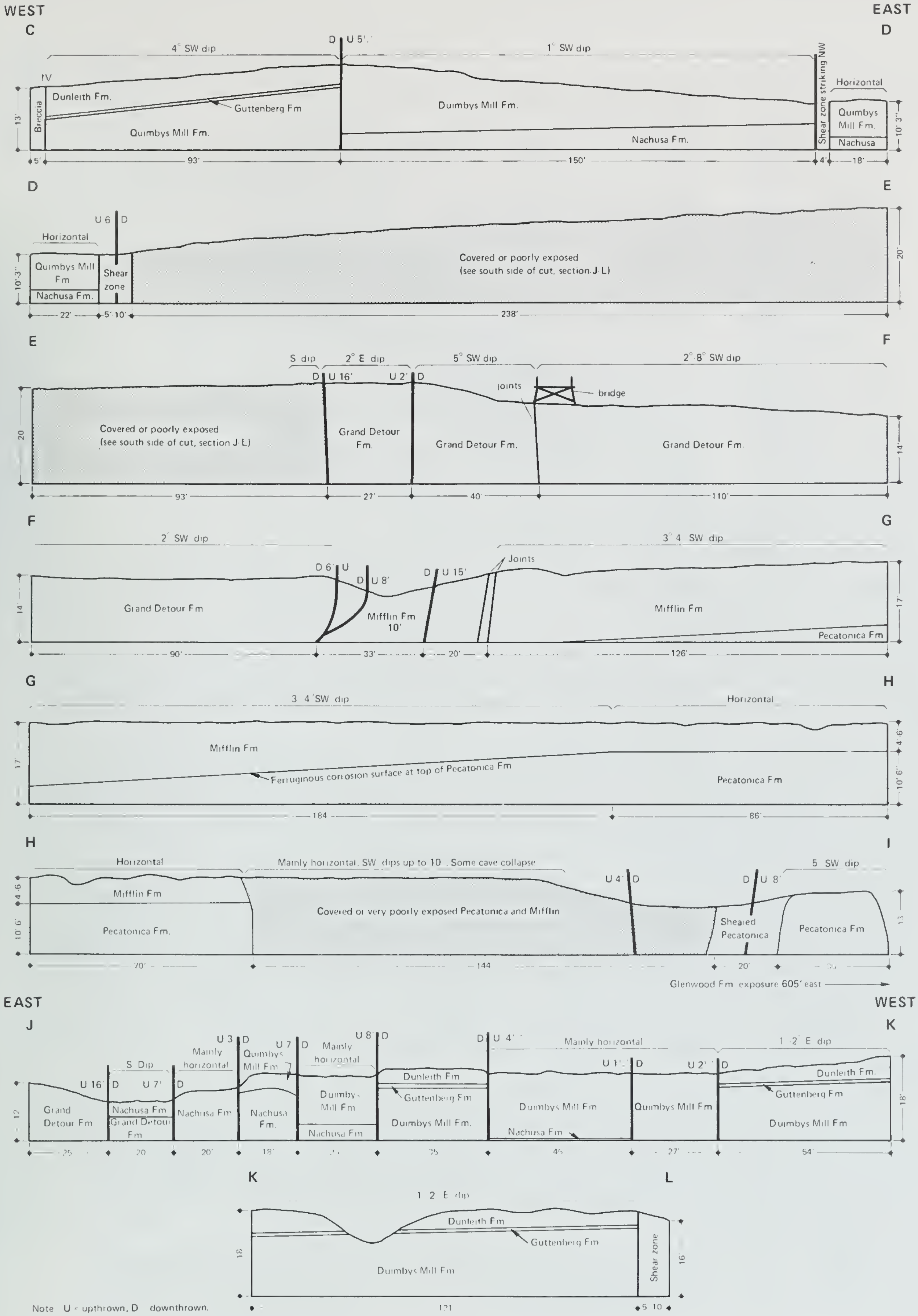


Figure 13a Cross sections AB and BC of the Sandwich Fault Zone exposed in the Burlington Northern Railroad cut about 3 miles southwest of Oregon (NW NW SE and NE SW Sec. 7, T. 23 N., R. 10 E.).
Figure 13b (right) Remaining cross sections from the Burlington Northern Railroad cut (Templeton and Willman 1952).



WEST
EAST
C
D
4° SW dip
1° SW dip
D U 5'
Breccia
Dunleith Fm.
Guttenberg Fm
Quimbys Mill Fm.
Quimbys Mill Fm.
Shear zone striking NW
Horizontal
Quimbys Mill Fm.
Nachusa Fm.
Nachusa
13'
10' 3"
5'
93'
150'
4'
18'
D
E
U 6 D
Horizontal
Quimbys Mill Fm
Nachusa Fm.
Shear zone
Covered or poorly exposed
(see south side of cut, section J-L)
10' 3"
20'
22'
5'-10'
238'
E
F
S dip
2° E dip
5° SW dip
2°-8° SW dip
D U 16'
U 2' D
joints
bridge
Covered or poorly exposed
(see south side of cut, section J-L)
Grand Detour Fm.
Grand Detour Fm.
Grand Detour Fm.
20
14'
93'
27'
40'
110'
F
G
2° SW dip
3°-4° SW dip
D 6' U
D U 8'
D U 15'
Joints
Grand Detour Fm
Mifflin Fm
10'
Mifflin Fm
Pecatonica Fm
14'
17'
90'
33'
20'
126'
G
H
3-4° SW dip
Horizontal
Mifflin Fm
Ferruginous corrosion surface at top of Pecatonica Fm
Pecatonica Fm
17'
4'-6'
10'-6'
184'
86'
H
I
Horizontal
Mainly horizontal, SW dips up to 10°. Some cave collapse
5° SW dip
U 4' D
D U 8'
Mifflin Fm
Pecatonica Fm.
Covered or very poorly exposed Pecatonica and Mifflin
Sheared Pecatonica
Pecatonica Fm
4'-6'
10'-6'
13'
70'
144'
20'
Glenwood Fm. exposure 605' east
EAST
WEST
J
K
U 3 D
U 7 D
U 8' D
D U 4'
S Dip
Mainly horizontal
Mainly horizontal
Mainly horizontal
1-2° E dip
U 16' D
U 7' D
U 1' D
U 2' D
Grand Detour Fm
Nachusa Fm
Grand Detour Fm
Nachusa Fm
Quimbys Mill Fm
Nachusa Fm.
Quimbys Mill Fm
Nachusa Fm
Dunleith Fm
Guttenberg Fm
Quimbys Mill Fm.
Quimbys Mill Fm
Nachusa Fm
Quimbys Mill Fm
Dunleith Fm.
Guttenberg Fm
Quimbys Mill Fm
12'
18'
25'
20'
20'
18'
35'
45'
27'
54'
K
L
1-2° E dip
Dunleith Fm
Guttenberg Fm
Quimbys Mill Fm
Shear zone
18'
16'
121'
5-10'
Note: U = upthrown, D = downthrown.

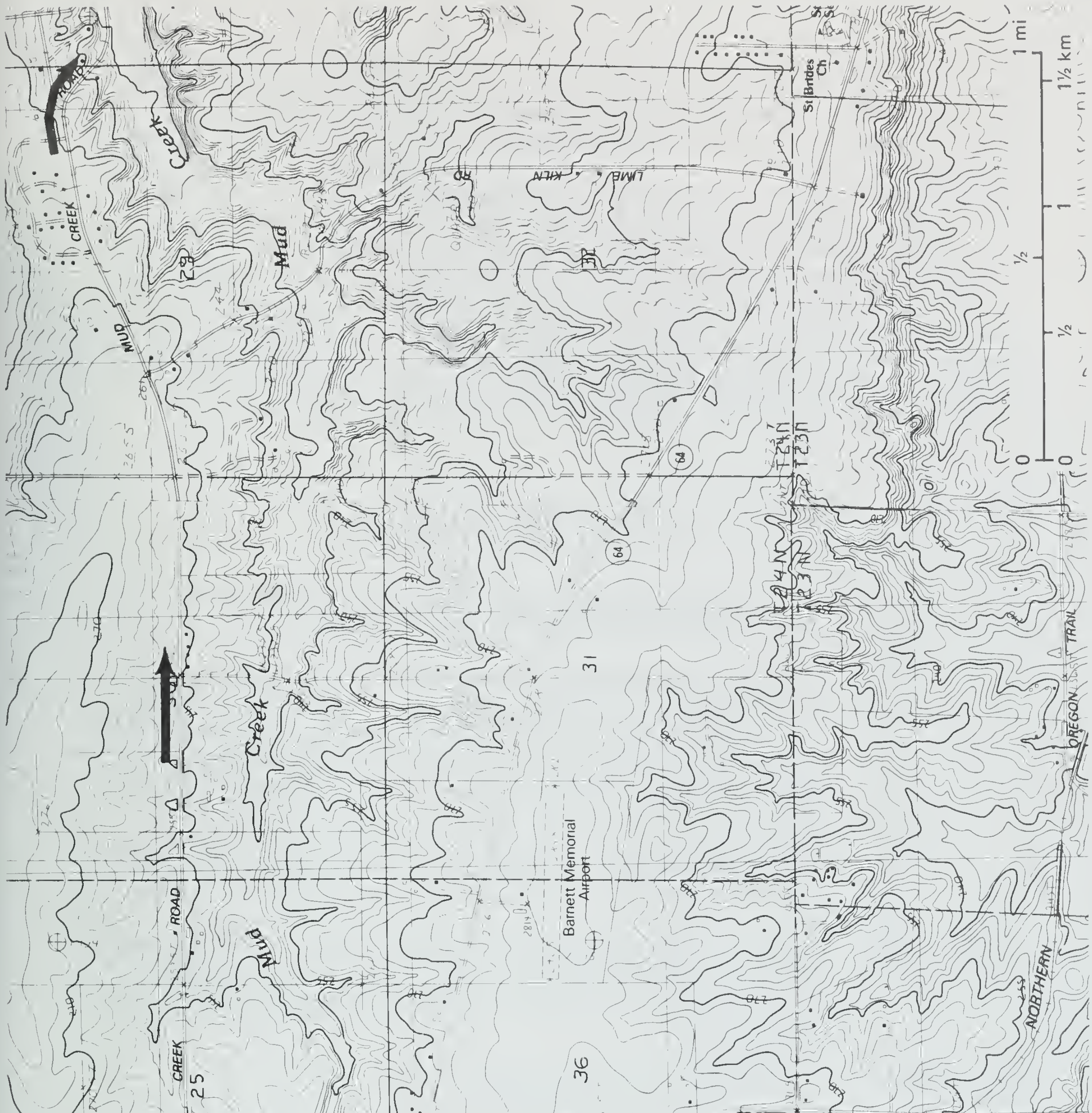
0.5+	7.3+	BEAR RIGHT (west) on Pines Road.
0.3	7.6+	Prepare to turn right at Y-intersection ahead.
0.15+	7.8	BEAR RIGHT and STOP: 1-way. Traffic from left does NOT stop. TURN RIGHT (north) on Ridge Road.
1.8+	9.65	CAUTION: unguarded, single-track BN Railroad grade crossing.
1.3+	10.95+	STOP: 1-way at T-intersection. CAUTION: TURN LEFT (west) on SR 64.
0.25	11.2+	Prepare to turn right ahead.
0.1+	11.3+	TURN RIGHT (north) on Leaf River Road on the east side of Mt. Morris.
0.2+	11.55	You are crossing the high point on the route here - slightly more than 915 feet m.s.l.
0.05+	11.6+	Prepare to park ahead.
0.1+	11.75+	PARK along the road shoulder as far off the road as you can safely.

STOP 3 View from the upland eastward toward the Rock River Valley (ca. ctr W line NW NW SW Sec. 25, T24N, R9E, 4th P.M., Ogle County, Mt. Morris 7.5-minute Quadrangle [42089A4]).

As noted in the introduction, the Oregon area is located in the Rock River Hill Country (fig. 7), a scenic region of gently rolling, glaciated uplands. This area has not always looked the way it does today. During the millions of years that this region was above sea level, erosion gradually wore the old land irregularities down nearly to a low-lying, flat, relatively featureless surface called a peneplain. The uppermost ridge crests in northwestern Illinois have a uniformity (concordance) of heights that lends support to the concept of the development of an ancient peneplain, called the Dodgeville, that was later uplifted and subsequently eroded. Remnants of the Dodegeville now have elevations in excess of 1,100 feet m.s.l. The next cycle of erosion removed much of the Dodgeville, leaving only those scattered remnants in northwestern Illinois and adjacent areas. A new, lower surface was partially developed some 150 feet lower, the Lancaster Peneplain. This new surface sloped southward from about 1,000 feet to approximately 900 feet. The concordance of heights in the Oregon field trip area suggests that we are seeing remnants of this later peneplain in the higher elevations here.

The preglacial Rock River developed across the Lancaster Peneplain and steadily eroded its channel downward as the region was uplifted gradually above sea level. The present undulating topography reflects the irregularities of the bedrock surface, which is only thinly mantled by unconsolidated glacial deposits. During the Pleistocene Epoch, popularly called the Great Ice Age, the region was covered by glaciers of the Illinoian Stage (see attached *Pleistocene Glaciations in Illinois*).

West of this vantage point the land is higher and more gently rolling. That is because the stream network is growing headward and stream erosion has not dissected the surface as



MUD CREEK ROAD
Mud Creek
Barnett Memorial Airport
LEAF RIVER
RIDGE ROAD
BURLINGTON NORTHERN
OREGON TRAIL
LIME KILN RD
St Brides Ch
T24N
T23N
25
36
31
29
64
3
0 ½ 1 mi
0 ½ 1½ km

much as it has toward the east, where tributaries are trying to keep pace in downcutting with the master stream, the Rock. Thus this land to the west is more youthful in its development; there are uplands, gentle hill slopes, and rather small valleys, many with V-shaped cross sections. However, the land in front of us toward the Rock River, some 3 miles to the east, is rough and highly dissected by a good natural drainage network developed on and in it. This area, therefore, is in a stage of early maturity in its development; there are still small scattered upland remnants, the valley bottoms contain some flat areas alongside the streams, and the area is largely in slopes. Our vantage point is about 902 feet m.s.l., and the river is about 660 feet m.s.l. The land surface slopes gently down vertically for about 115 feet to the bluffs on the west side of the river about 3 miles away. These bluffs stand about 130 feet above the river. East of the river, on the other hand, the land is slightly rolling, but within a short distance it becomes flat, and the drainage is poor in the silt loam soil. (NOTE: early morning, low-lying light fog or heavy haze enhances the contrasts to the east from this vantage point). After lunch we will discuss the history of the Rock River from the east bluff above the river.

0.0	11.75+	Leave Stop 3 and CONTINUE AHEAD (north).
0.05+	11.8+	STOP: 2-way. CAUTION: visibility somewhat limited to the left and traffic tends to be fast. TURN RIGHT (east) on Mud Creek Road.
1.5	13.3+	T-intersection to right (south) of Rock Road. We will CONTINUE AHEAD (easterly) on Mud Creek Road. NOTE: a long-abandoned quarry on the south side of Mud Creek, about 0.3 mile south of this intersection, showed steeply tilted Ordovician Galena strata that were highly fractured along what became known as the Mud Creek Fault. The sides of the old quarry have slumped badly and become part of a pasture, so details of the structure would be exceedingly difficult to see now. Roadside exposures are so limited that they are of little use. A large Illinoian outwash gravel deposit is exposed in the east road-cut on the north side of Mud Creek.
0.7+	14.05+	CAUTION: T-intersection (Limekiln Road) from right. CONTINUE AHEAD (easterly) on Mud Creek Road. NOTE: remnants of a long abandoned lime kiln are along a north-flowing tributary to Mud Creek a little over 0.5 mile to the south.
0.65+	14.7+	CAUTION: descend into Mud Creek valley.
0.5+	15.2+	STOP: 1-way at T-intersection. CAUTION: fast traffic from left. TURN RIGHT (southerly) on SR 2. NOTE: the Rock River here is slightly more than 0.1 of a mile wide and its valley at its narrowest is approximately 0.25 mile wide.
1.0	16.2+	For the next mile or so, there will be a number of excellent views of the towering concrete statue of an American Indian (popularly called "Black Hawk") perched high on the east bluff of the Rock River in Lowden State Park.

MUD
CREEK
ROAD
Mud
Creek
Barnett Memorial
Airport
LEAF
RIVER
OREGON
TRAIL
NORTHERN
BURLINGTON
RIDGE
ROAD
LIME
KILN
RD
St Brides
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T24N
T23N
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64
25
29
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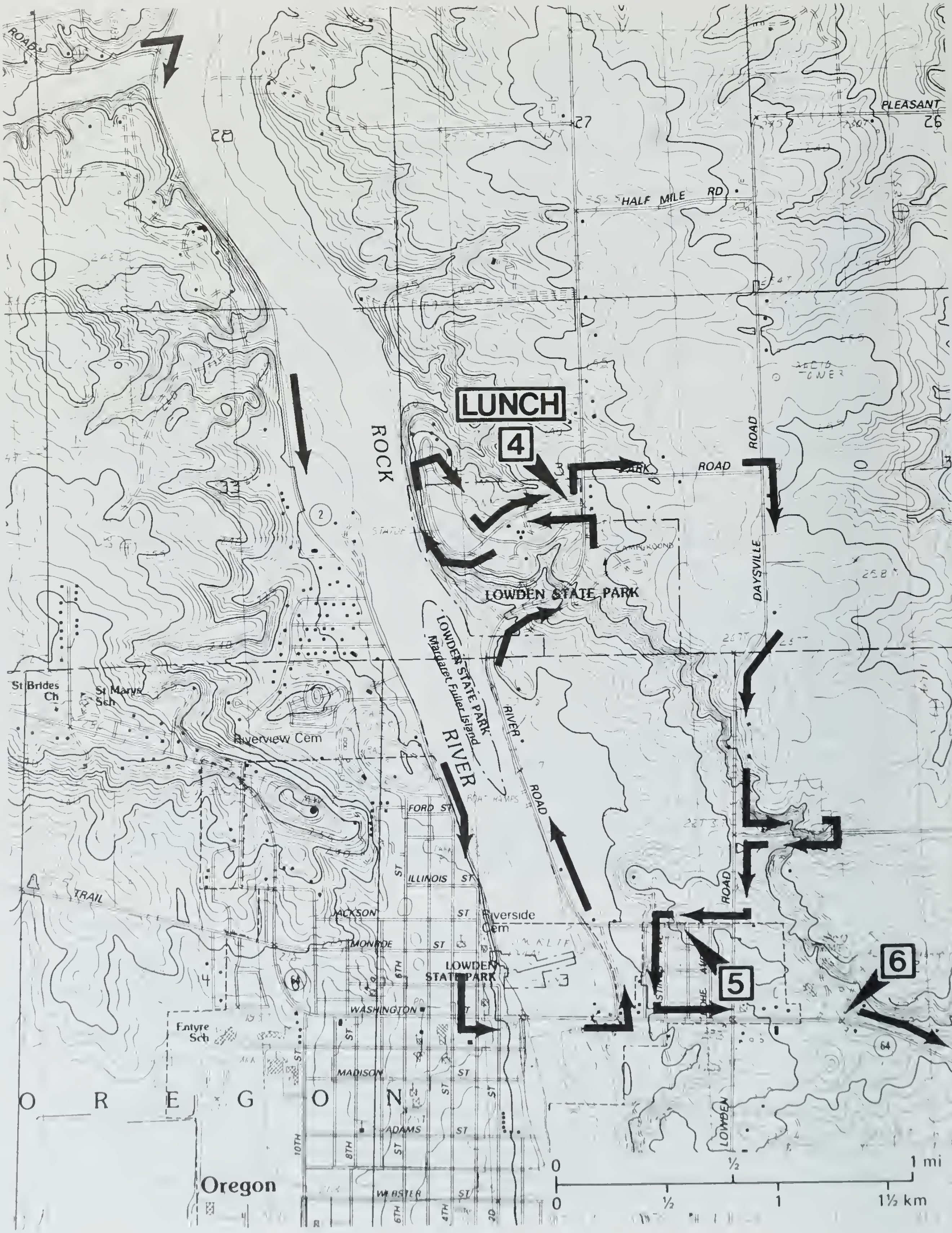
much as it has toward the east, where tributaries are trying to keep pace in downcutting with the master stream, the Rock. Thus this land to the west is more youthful in its development; there are uplands, gentle hill slopes, and rather small valleys, many with V-shaped cross sections. However, the land in front of us toward the Rock River, some 3 miles to the east, is rough and highly dissected by a good natural drainage network developed on and in it. This area, therefore, is in a stage of early maturity in its development; there are still small scattered upland remnants, the valley bottoms contain some flat areas alongside the streams, and the area is largely in slopes. Our vantage point is about 902 feet m.s.l., and the river is about 660 feet m.s.l. The land surface slopes gently down vertically for about 115 feet to the bluffs on the west side of the river about 3 miles away. These bluffs stand about 130 feet above the river. East of the river, on the other hand, the land is slightly rolling, but within a short distance it becomes flat, and the drainage is poor in the silt loam soil. (NOTE: early morning, low-lying light fog or heavy haze enhances the contrasts to the east from this vantage point). After lunch we will discuss the history of the Rock River from the east bluff above the river.

0.0	11.75+	Leave Stop 3 and CONTINUE AHEAD (north).
0.05+	11.8+	STOP: 2-way. CAUTION: visibility somewhat limited to the left and traffic tends to be fast. TURN RIGHT (east) on Mud Creek Road.
1.5	13.3+	T-intersection to right (south) of Rock Road. We will CONTINUE AHEAD (easterly) on Mud Creek Road. NOTE: a long-abandoned quarry on the south side of Mud Creek, about 0.3 mile south of this intersection, showed steeply tilted Ordovician Galena strata that were highly fractured along what became known as the Mud Creek Fault. The sides of the old quarry have slumped badly and become part of a pasture, so details of the structure would be exceedingly difficult to see now. Roadside exposures are so limited that they are of little use. A large Illinoian outwash gravel deposit is exposed in the east road-cut on the north side of Mud Creek.
0.7+	14.05+	CAUTION: T-intersection (Limekiln Road) from right. CONTINUE AHEAD (easterly) on Mud Creek Road. NOTE: remnants of a long abandoned lime kiln are along a north-flowing tributary to Mud Creek a little over 0.5 mile to the south.
0.65+	14.7+	CAUTION: descend into Mud Creek valley.
0.5+	15.2+	STOP: 1-way at T-intersection. CAUTION: fast traffic from left. TURN RIGHT (southerly) on SR 2. NOTE: the Rock River here is slightly more than 0.1 of a mile wide and its valley at its narrowest is approximately 0.25 mile wide.
1.0	16.2+	For the next mile or so, there will be a number of excellent views of the towering concrete statue of an American Indian (popularly called "Black Hawk") perched high on the east bluff of the Rock River in Lowden State Park.

0.45+	16.7+	We are due west of the Indian statue.
0.65+	17.35+	Oregon City Limits.
0.55	17.9+	CAUTION: entering business district.
0.15+	18.1+	CAUTION: STOPLIGHT at 4th and Washington Streets. TURN LEFT (east) on Washington/SR 64.
0.05+	18.15+	CAUTION: STOPLIGHT at 3rd Street. CONTINUE AHEAD (east) on SR 64.
0.1+	18.3+	Cross Rock River. View to left of concrete dam just north of the highway bridge and Indian statue on the east river bluff in the distance.
0.15	18.5	Prepare to turn left ahead.
0.1-	18.55+	CAUTION: TURN LEFT (northerly) at River Road T-intersection. The route now follows northward along the narrow Rock River flood plain built on valley train deposits. Less than a mile to the east is a 150 foot high bluff capped by Ordovician Galena-Platteville dolomite. The underlying St. Peter Sandstone rapidly erodes except where protected by the resistant capping dolomite. An erosional line of cliffs protected by hard capping strata is called an escarpment.
1.35	19.9+	Good roadcut exposure of Platteville dolomite dipping about 7° to the northeast.
0.2	20.15	Prepare to turn left at entrance to Lowden State Park.
0.05+	20.2+	CAUTION: TURN LEFT (west) into Lowden State Park (entrance - NE cor. SE NE NE SW Sec. 34, T24N, R10E, 4th P.M., Ogle County, Oregon 7.5-minute Quadrangle [42089A3]). Picnic tables, shelters, and restroom facilities are found in several places. After lunch MEET for a discussion at the base of the statue to the American Indian. Resume mileage figure at park entrance.

STOP 4 The park area was purchased in 1898 by Wallace Heckman, a Chicago attorney who with his wife was a patron of the arts. They invited a group of Chicago artists to use the site, and the colony became known as the "Eagles' Nest" after a gaunt, dead cedar tree clinging precariously to the high river bluffs where eagles once nested. The colony flourished until 1942 when the last of the artists and their families left. After Governor Lowden died in 1943, the Illinois Legislature appropriated funds for a memorial to him. This money, plus matching funds from local citizens and the Division of Parks and Memorials, enabled this area to become Lowden State Park in 1945. In August 1951, 66 acres formerly known as the "Eagles' Nest" were transferred to Northern Illinois University to be used year round for its natural science courses in an outdoor teacher education program. This area and its buildings, now known as the Lorado Taft Campus, are located several hundred feet north and east of the statue.


LUNCH
4
5
6
ROCK
RIVER
LOWDEN STATE PARK
LOWDEN STATE PARK
Margaret Fuller Island
RIVER ROAD
PARK ROAD
DAYSVILLE ROAD
HALF MILE RD
PLEASANT
St Brides Ch
St Marys Sch
Riverview Cem
Riverside Cem
FORD ST
ILLINOIS ST
JACKSON ST
MONROE ST
WASHINGTON
MADISON ST
ADAMS ST
WEBSTER ST
LOWDEN ROAD
O R E G O N
Oregon
TRAIL
0 ½ 1 mi
0 ½ 1 1½ km

Sculptor Lorado Taft spent much time here and was inspired to create his memorial to the American Indian after walking past this spot countless times and contemplating the magnificent surroundings, which were among the things so important to the Indian Chieftain Black Hawk. Taft created a 6-foot plaster model. Chicago Art Institute sculptor John G. Prasuhn, who had a working knowledge of cement, became interested in the project and undertook the enlargement and the cement work. The gigantic, monolithic, reinforced-concrete figure of an American Indian was dedicated on July 1, 1911. A park brochure states that the statue is 42 feet 6 inches high with a 6-foot high concrete base. Reinforced with iron rods, the statue is hollow and varies in thickness from 8 inches to 3 feet. The outer surface is 3 inches thick and is composed of cement, pink granite chips, and screenings poured simultaneously with the cement. The figure, called "Black Hawk" by the public, is estimated to weigh 100 tons.

Following the war named after him, Black Hawk said: "Rock River was a beautiful country. I liked my towns, my corn fields, and the home of my people. I fought for it. It is now yours. Keep it, as we did."

The Rock River was not always as Black Hawk knew it during the 1800s. Before the glaciers invaded northern Illinois, the Ancient Rock River flowed southward from Rockford to the vicinity of Princeton, where it joined the southeastward-trending Ancient Mississippi River (fig. 14). The Rock River Valley lay about 18 miles east of Oregon and was joined by three major eastward-flowing tributaries that followed the present valleys of the Pecatonica, Leaf, and Kyte Rivers and Stillman and Gale Creeks. Preglacial Pine Creek flowed southward for about 6 miles past Grand Detour and then turned southwestward, passing south of Dixon to join the Ancient Rock River.

Although the region was completely covered by the Illinoian glacier, at least some of the drainage continued to follow part of the pre-Illinoian courses after the glacier melted away. Even though glaciers did not cover this area during early Wisconsinan time, they did stand across regions to the north in Wisconsin. Meltwater from these glaciers, coursing through this area laden with outwash debris, choked the Rock Valley south of Rockford. Behind this dam of outwash debris, the waters of Rock River backed up in the Leaf River-Stillman Creek valley until they overtopped the bedrock divide between Byron and Oregon. The waters poured over the divide into the valleys of Pine Creek and Elkhorn Creek and then flowed southward to the Ancient Mississippi River. The "new" Rock River eroded down through the bedrock divide and produced the deep, narrow gorge that bends around Lowden State Park here. Because thick outwash deposits blocked Pine Creek Valley south of Grand Detour, the river swung northward around the Grand Detour loop and then turned southwestward past Dixon along a tributary of Elkhorn Creek. At Sterling the Rock River assumed the valley of the southeastward-flowing Elkhorn Creek.

The Shelbyville ice sheet, representing the initial advance of the Wisconsinan Woodfordian glacier, invaded the eastern and southern parts of the region. Advancing from the east, this ice did not get into the field trip area. However, much outwash flushed out to the west and south as the Woodfordian ice melted and the Ancient Rock River Valley south of Rockford was permanently abandoned. The river was forced westward between Rockford and Byron. Flowing around the front of these thick outwash deposits, the Rock River cut another deep bedrock gorge, through which it still flows. The flow of Stillman Creek and Kyte River was reversed, and these streams now flow westward into the Rock River.

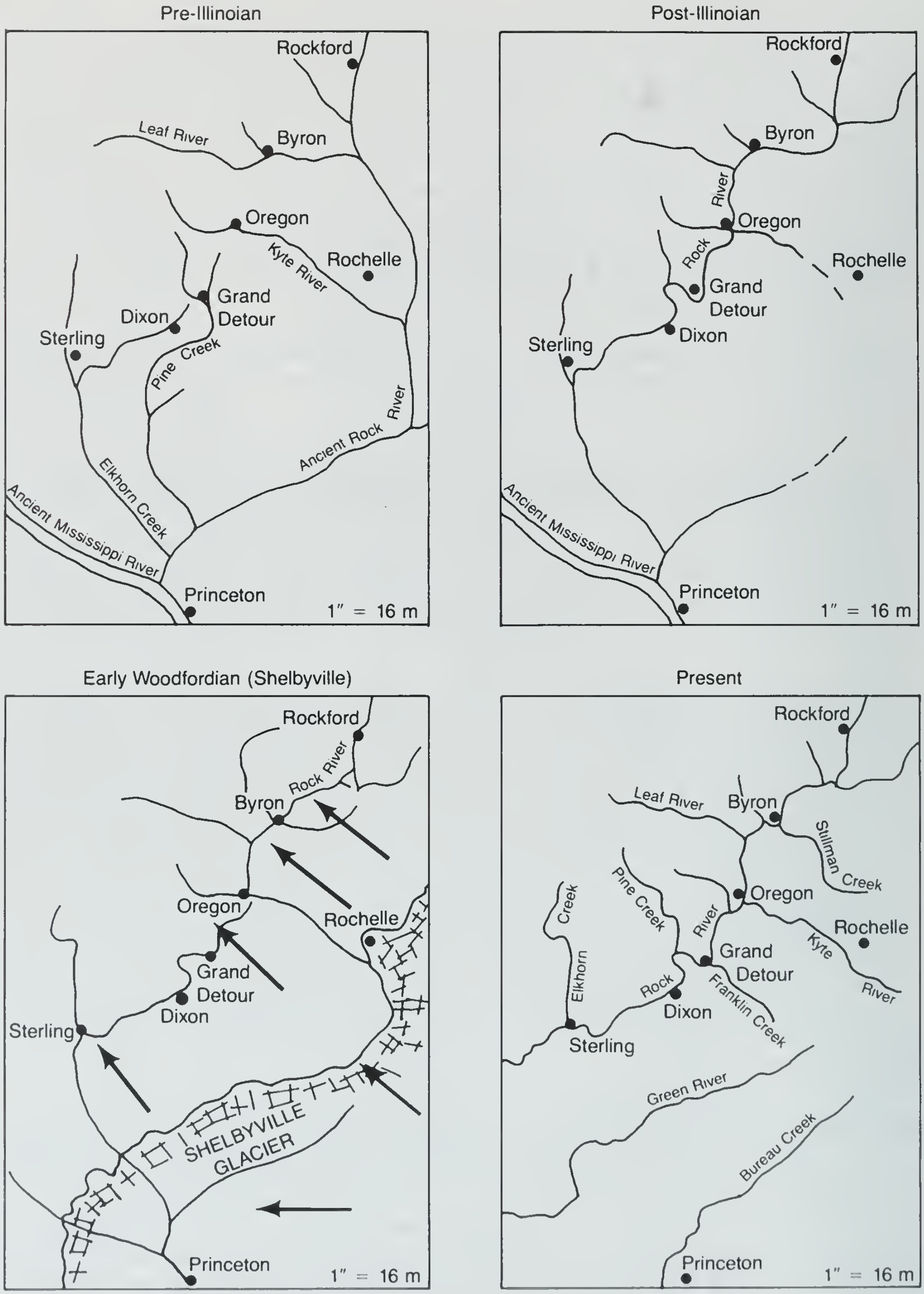


Figure 14 Pleistocene drainage changes of Rock River.

The early Woodfordian glacier also extended westward into the Green River Lowland. The Shelbyville ice permanently diverted the Ancient Mississippi River westward where it eroded its present valley. When the glacier melted away, the Rock River was able to maintain its course from Oregon to Sterling, but it abandoned its channel between Sterling and Princeton because of the thick outwash deposits. Instead, it eroded its present valley southwestward to the present Mississippi River.

Melting of the Green Bay Lobe of the Woodfordian Valparaiso glaciation, which reached Janesville, Wisconsin, produced a valley train of sand and gravel down the Rock River Valley. Deposition of this debris reduced the topographic relief of the valley by about 100 feet, according to Templeton and Willman (1952). The surface of this valley train is about 45 feet above the present flood plain. Subsequent downcutting of the Mississippi and Rock Rivers and deposition of still later valley train material produced a lower terrace about 20 feet above the present Rock River flood plain.

Rock River drains an area of Wisconsin and Illinois of approximately 11,000 square miles, about 5,210 square miles of that in Illinois. The watershed of Rock River, not including its main tributaries (the Pecatonica, the Kishwaukee, and the Green Rivers), contains 2,260 square miles and covers, from north to southwest, parts of Boone, Winnebago, Ogle, Carroll, Lee, Whiteside, Henry, and Rock Island Counties.

Rock River is 286 miles long, with about 157 miles in Illinois. In the 108.5 miles from Janesville (12 miles north of Illinois by river) to Sterling, the river falls 134 feet—somewhat more than 1.25 feet per mile—at a fairly constant rate. Several dams for hydroelectric power generation were constructed across the river, including the privately owned one just north of the SR 64 bridge at Oregon.

Because Rock River is an interstate, navigable stream, the federal government at one time studied the feasibility of dredging a 7-foot navigable channel, along with the necessary dams and locks. The project never got under way because the commerce that might be expected as a result of the proposed improvement would not warrant the cost of the construction.

0.0	20.2+	Leave Stop 4. STOP: 1-way. CAUTION: limited visibility and fast traffic. TURN LEFT (north) on River Road and prepare to turn right just ahead.
0.05+	20.25+	TURN RIGHT (east) on Park Road.
0.35+	20.6+	View to the left about 11 o'clock of the twin cooling towers of the Commonwealth Edison Nuclear Power Plant, Byron Station.
0.1+	20.75+	STOP: 1-way. T-road intersection. TURN RIGHT (south) on the Daysville Road.
0.65	21.4+	CAUTION: Steep downgrade just ahead. Excellent exposures of Galena-Platteville rocks from top downward. Don't be distracted too much and veer off the road to the right over the cliff. Prepare to turn left at the bottom of the hill.

0.35+	21.8+	TURN LEFT (east) on Brick Road at the T-road intersection.
0.15	21.95+	The tilted strata here range from Platteville near the base of the cut up into Galena rocks near the top. Strata are inclined (dip) toward the northeast from 8 to 15 degrees. A couple of small quarries operated along the north side of the road many years ago.
0.1+	22.1+	TURN AROUND at the top of the hill and retrace route westward to Daysville Road.
0.25+	22.4	STOP: 1-way at T-road intersection. CAUTION: fast traffic. TURN LEFT (south) on Daysville Road.
0.15	22.55	Prepare to turn right.
0.1	22.65	TURN RIGHT (west) on Mix Lane at T-road intersection and prepare to park ahead.
0.1+	22.75+	PARK as far off the roadway as you can safely. This high point gives a good view of the downtown area of Oregon ahead and to the left. CAUTION: roadway is narrow and visibility is restricted.

STOP 5 Examine the oldest Cambrian strata exposed at the bedrock surface in Illinois (S side of Mix Lane NW cor. NE NE NE and W down hill along N edge NE NW NE NE Sec. 2, T23N, R10E, 4th P.M., Ogle County, Oregon 7.5-minute Quadrangle [42089A3]).

There is a long-abandoned quarry slightly north and east from the stone entrance pillars, down the hill from us on the north side of Mix Lane. Now very much overgrown, the rocks in the working face are only poorly exposed. In the lower part of this quarry, the Cambrian Franconia Formation is exposed. This is the oldest formation that comes to the surface anywhere in Illinois. The section described here was:

CAMBRIAN SYSTEM

Trempealeauan Stage

Potosi Formation (23 ft)

Dolomite, tan, thin-bedded, slightly argillaceous and glauconitic, shows wavy bedding, sparingly fossiliferous, upper 4 to 5 feet deeply weathered.

Franconian Stage

Franconia Formation (10 ft)

Sandstone and dolomite, buff with greenish cast because of presence of mineral glauconite, argillaceous, fossiliferous including trilobites

The quarried rock was used in the construction of the power-generating dam across the Rock River here. Strata dip 7 to 10 degrees northeast here along the northeast flank of the Oregon Anticline. On the northeast side of the hill, St. Peter Sandstone crops out. However, in this locality, the St. Peter is quartzitic, the result of alteration brought about by nearby faulting.

Some of these rocks are poorly exposed in the ditch along the south side of the roadway. On this side of the road, conditions are somewhat confusing because the St. Peter Sandstone crops out at a lower elevation than does the Potosi Formation. Some of the large blocks of sandstone to the southeast near the top of the ridge are brecciated, quartzitic St. Peter. A number of interesting problems are posed by features observed here. None of them can be readily answered, especially when so many things are now covered and/or rearranged by man. Did the deep weathering of the Potosi occur before the St. Peter was deposited, or is it post-Paleozoic in age? Does the small thrust fault present account for the localized development of the brecciated, quartzitic St. Peter? There is some evidence that indicates the presence of an old channel south of the road that is filled with St. Peter, thus permitting the St. Peter to abut the Potosi Dolomite.

The granular, green mineral glauconite $(K,Na)(Al,Fe+^{3},Mg)_2(Al,Si)_4O_{10}(OH)_2$ belongs to the mica group of minerals. It is also called greensand and is found in marine sedimentary rocks, where it is an indicator of very slow deposition.

0.0	22.75+	Leave Stop 5 and CONTINUE AHEAD (west) a short distance.
0.05+	22.8+	TURN LEFT (south) on Hastings Avenue.
0.05	22.85+	St. Peter Sandstone is exposed behind the small houses to the left.
0.05+	22.95+	STOP: 2-way at Center Street. CONTINUE AHEAD (south).
0.1+	23.05+	STOP: 1-way at T-intersection with Washington Street/SR 64. CAUTION: fast traffic and somewhat limited visibility. TURN LEFT (east).
0.15+	23.25+	CAUTION: Daysville Road (Jewett Avenue) intersection. CONTINUE AHEAD (east).
0.15	23.45	On the left (north) side of SR 64 is an exposure of the upper part of the St. Peter Sandstone. Here the sandstone is not only white but has some bands of green (glauconite) as well as some yellow-brown ochre-like material near the top. Towards the east end of the cut, the sandstone is much more weathered and soft. The strata are inclined some 7 degrees or so.
0.05	23.5	CONTINUE AHEAD and prepare to turn left.
0.1	23.6	CAUTION: TURN LEFT (north) into the Oregon Stone Company entrance haulroad. Mileage figures will resume from this point. You MUST have permission to enter this property. Stay in the lower levels. Do NOT climb on rock ledges or go up the slope around the ends. The stone is jointed and fractured and thus can be dangerous. Be careful where you step and note carefully what is above your head—don't remove the "keystone" to the whole face. Stay close to the leaders and follow directions.

STOP 6 Examine Middle Ordovician strata in the Oregon Stone Company quarry (haulroad entrance - N side SR 64 NE NW SW NE Sec. 2, T23N, R10E, 4th P.M., Ogle County, Oregon 7.5-minute Quadrangle [42089A3]). The following section (Willman and Kolata 1978) is typical of the rocks exposed and quarried here:

ORDOVICIAN SYSTEM

Galena Group

Dunleith Formation (21 ft 6 in)

Dolomite, buff, medium grained; 3- to 12-inch beds (18 ft)

Dolomite, brown, mottled; 3- to 10-beds; thin, green shaly partings; fossiliferous. (3 ft 6 in)

Platteville Group

Quimbys Mill Formation (14 ft 7in)

Dolomite, buff, fine grained, dense; 1/4- to 2-inch beds; smooth bedding surfaces; large chert nodules in upper part. (1 ft 3 in)

Dolomite, bluish gray to buff, dense; 1- to 3-inch beds; smooth flat to gently undulating bedding surfaces; chert nodules along bedding surfaces (4 ft 3 in)

Dolomite, as above but massive. (3 ft)

Dolomite, as above but mostly 5-inch beds; numerous small, white chert nodules; 1-inch bluish gray to buff, dolomitic shale at top (1 ft)

Dolomite, bluish gray to bufff, fine grained, dense; 1- to 5-inch beds; smooth, flat to gently undulating bedding surfaces with thin shaly partings; reentrant at top. (5 ft 1 in)

Nachusa Formation (19 ft 7 in)

Everett Member - Dolomite,pure, cherty, bluish gray to buff, mottled, medium grained; 9- to 13-inch beds; rough weathered face; fossiliferous. (6 ft 10 in)

Elm Member - Dolomite, slightly argillaceous, bluish gray to buff, dense, fine grained; prominent shaly partings 9- and 18-inch below top; smooth weathered face (3 ft 5 in)

Eldena Member - Dolomite, like Everett Member above but without chert. (9 ft 4 in)

Grand Detour Formation (25 ft 10 in)

Forreston Member - Dolomite, argillaceous, gray to buff, fine grained, laminated; fossiliferous; weathers to 1- to 2-inch wavy, lenticular beds; thick, dark brown shaly partings; 18-inch bed at top transitional to Nachusa Formation. (13 ft 2 in)

Stillman Member - Dolomite, relatively pure, gray, mottled buff, vuggy; 4- to 8-inch even beds; thin shaly partings. (12 ft 8 in)

Most geologists believe that dolomites were originally deposited as limestone by the chemical precipitation of calcium carbonate ($CaCO_3$) from sea water and by the accumulation of the calcareous remains of marine plants and animals. At some time after their deposition, the limestones were changed or dolomitized to dolomites.

During dolomitization, magnesium ions replace calcium ions in the atomic structure of the mineral calcite ($CaCO_3$). Based upon the degree of dolomitization, a carbonate rock is classified as limestone (0-10% dolomite), dolomitic limestone (10-50% dolomite), calcitic dolomite (50-90% dolomite), or dolomite (90-100% dolomite). In pure dolomite, the calcium-magnesium ratio is about one to one. Small amounts of ferrous iron usually replace some of the magnesium in dolomite, resulting in the characteristic light brown color of most weathered dolomite formations. Recrystallization also takes place during dolomitization, in many cases producing a sucrosic (sugary) texture that is also characteristic of many dolomites. Because of this recrystallization, primary sedimentary structures, such as current features and fossil remains, are destroyed or at best are only poorly preserved.

Geologists do not agree on the origin of the dolomites. Some geologists believe that dolomitization takes place soon after deposition, when the unconsolidated, limy sediments are still in contact with the sea water. Magnesium in the sea water is exchanged for calcium in the sediments by a reaction with the sea water that bathes the upper part of the sediments. Other geologists believe that dolomitization takes place after the limy sediments have been consolidated to limestone, by a reaction with magnesium-rich formation water (connate water) that was trapped in the limy sediments or in associated sandstones and shales during deposition. Another idea is that dolomitization is accomplished by groundwater that becomes charged with magnesium from the zone of weathering at the Earth's surface. The magnesium-rich groundwater percolates through the pores and cracks (joints) in the limestones altering them to dolomites. Recent work in shallow seas in arid climates where no clastics (sands and muds) are being washed in has shown that primary dolomite has formed. Additional work seems to indicate that there are other limited conditions and areas in which it can be precipitated directly. Needless to say, the answer has not been found.

0.0	23.6	Leave Stop 6. STOP: 1-way. CAUTION: fast traffic and somewhat limited visibility. TURN LEFT (southeasterly) on SR 64.
0.45+	24.05+	Intersection with Blackhawk Road. CONTINUE AHEAD (easterly).
1.15	25.2+	Prepare to turn right.
0.1	25.3+	TURN RIGHT (south) onto Marsh Road at T-intersection.
0.25	25.55+	Prepare to park ahead.
0.1+	25.65+	PARK as far off the roadway as you can safely. Please do NOT block the driveways or field entrances. CAUTION: good road, fast traffic, limited visibility from the north. Stay down below. Do NOT get up on top of the exposure. Again, be careful where you stand and note what is above your head. Do NOT stand under any overhangs.

STOP 7 Examination of Illinoian glacial deposits (entrance - E line SE SE SE SE Sec. 1, T23N, R10E, 4th P.M., Ogle County, Oregon 7.5-minute Quadrangle [42089A3]).


PINE ROCK
Honey Creek
Honey Creek
7
RASMUSSEN
ROAD
MARSH ROAD
MARSH RD
RIDE
BLACKHAWK
BLACKHAWK ROAD
BURLINGTON ROAD
NORTHERN ROAD
TRANSMISSION LINE
POWERLINE
SUBSTATION
HONEY CREEK ROAD
CREEK
HONEY
Watertown
KYTE
0
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1
1 mi
1½ km

Near the roadcuts, the glacial deposit appears to be a very sandy, pebbly till of Illinoian age. As you go westward down the ramp into the pit, note that the sides become increasingly sandy and contain a large number of cobbles, taking on the appearance of an outwash deposit. Boulders up to 3 feet across have been encountered in this mining operation. Note the variety in those set along the right-of-way line. The lower part of the pit shows well developed interlaminated sand and gravel beds that are several inches thick. The size of the material and its lack of much sorting indicates that it was flushed out of the glacial ice and dumped close to the ice margin.

You should be able to collect a number of excellent cobbles of different types of rocks from this deposit. Although you will find quite a few of the country rock (mainly dolomite), you will find many that have been brought in to this area from our neighbors to the north, including Canada. A fair number of these rocks are striated; that is, they have been frozen in the ice, at least partially rounded, and then scratched by neighboring harder rocks. In some cases, the rocks were frozen into the bottom of the glacier so that they formed a coarse "sandpaper," wearing down the country rock over which they slowly flowed (for additional information about glaciers, see *Pleistocene Glaciations in Illinois* and Geogram 2, *Erratics Are Erratic,* in the back of the guide leaflet).

0.0	25.65+	Leave Stop 7 and CONTINUE AHEAD (south).
0.5+	26.2+	Cross Honey Creek and prepare to turn left.
0.1+	26.3+	TURN LEFT (east) on Rasmussen Road at T-intersection.
1.3+	27.65+	TURN LEFT (north) and prepare to turn right.
0.05-	27.7	TURN RIGHT (east) on Rasmussen Road (Pine Rock Road goes north and west at this intersection).
0.45+	28.15+	CAUTION: unguarded T-intersection. TURN RIGHT (south) on Rocky Hollow Road.
0.3	28.5	Prepare to turn left.
0.1	28.6	TURN LEFT (east) on Cottonwood Road at T-intersection.
1.2+	29.85	STOP: 2-way at Chana Road. CAUTION: visibility somewhat restricted to the left. CONTINUE AHEAD (east) on Cottonwood Road.
0.7+	30.6	CAUTION: unguarded crossroad (Stonehill Road). CONTINUE AHEAD (east).
0.5	31.1	Prepare to park ahead.
0.1	31.2	PARK as far off the roadway as you can safely. CAUTION: traffic moves

moderately fast on this gravel road so it may be dusty. You MUST have permission to enter this small quarry from the Schabacker Brothers, across the road. Again, stay on the LOWER LEVEL ONLY. The quarry face can be dangerous. Be safety conscious for yourself AND others.

STOP 8 Examine and collect fossils from Platteville strata and discuss Illinois land surveys (entrance - apx. ctr. N line NE NW NW NE Sec. 14, T23N, R11E, 4th P.M., Ogle County, Chana 7.5-minute Quadrangle [41089H1]).

Strata exposed here are as follows (modified from Kolata and Willman 1978):

ORDOVICIAN SYSTEM

Platteville Group

Grand Detour Formation (3 ft)

Dolomite, buff, fine grained; 3- to 4-inch beds; weathered

Mifflin Formation (17 ft 6 in)

Dolomite, argillaceous, buff, fine grained, very fossiliferous (especially mollusks); 3- to 5-inch beds; thin shaly partings; 2- to 3-inch shaly bed at top. (10 ft 6 in)

Dolomite, argillaceous, bluish gray, weathered buff, fine grained, very fossiliferous; 1- to 3-inch wavy, lenticular beds; thick, greenish gray shaly partings; 1- to 2-foot shaly reentrant at top. (7 ft)

Ferruginous corrosion surface on top of Pecatonica Formation is exposed in floor at north end of quarry.

This locality also affords the opportunity to examine the system of land surveys in Illinois. An examination of the 15- and 7.5-minute quadrangles in the field trip area shows that section lines do not show an even grid pattern over the whole area. You will note that some sections are considerably larger than others.

In 1804, initial surveying from the 2nd P.M. (fig. 15) continued westward from Vincennes, Indiana; this survey became the basis for surveying about 10 percent of what is now eastern Illinois. Because the western boundary of this tract had not been established with certainty, it was decided in 1805 to designate the 3rd P.M. as beginning at the mouth of the Ohio River and extending northward to facilitate surveying new land cessions. By late 1805 a base line had been run due east to the Wabash River and due west to the Mississippi River from the 3rd P.M. During March 1806, surveying commenced northward on both sides of the 3rd P.M. Sometime after the selection of an initial point from which to establish a base line, and from which the surveys were to be laid out, the base line apparently was arbitrarily moved northward 36 miles, where it roughly coincides with the base line of the 2nd P.M.

The township and range system permits the accurate identification of most parcels of land in Illinois to facilitate the sale and transfer of public and private lands. In the early 1800s, each normal township was divided (to the best of the surveyor's ability) into 36 sections, each of which was 1 mile square and contained 640 acres (see route maps).

Township and range lines in figure 16 do not form a perfect rectangular grid over the state

END
8
Gravel Pit
Honey
Creek
GARNHART ROAD
STONEHILL ROAD
CHANA ROAD
COTTONWOOD ROAD
HONEY CREEK ROAD
BURLINGTON
NORTHERN
Chana
P I N E R O C K
RIVER
CANFIELD ROAD
ROCKY HOLLOW ROAD
BM 695
8
9
10
11
14
15
16
17
20
21
22
23
789
767
763
839
802
796
769
757
775
784
776
732
741
720
761
718
707
850
800
750
700
0 ½ 1 mi
0 ½ 1 1½ km

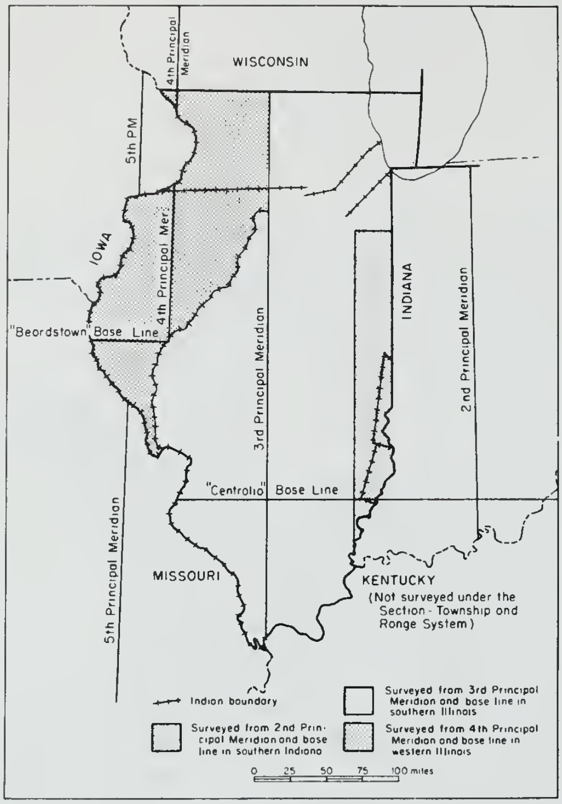

Figure 15 Principal meridians and base lines of Illinois and surrounding states (Cote 1978).

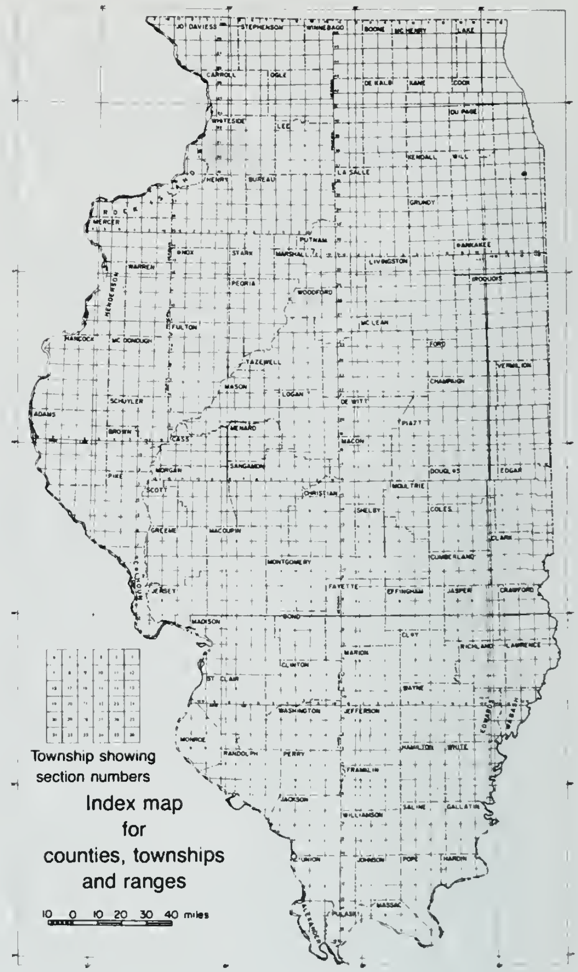

Figure 16 Index map (Cote 1978).

because of the use of different base lines and principal meridians and because minor offsets were necessary to compensate for the Earth's curvature. The surveying corrections producing the minor offsets were usually made at regular intervals of about 30 miles. Figure 16 shows what happened when the survey from the 2nd P.M. met the survey from the 3rd P.M. From Iroquois County south to White County, only narrow partial townships could be made where the two surveys met. These partial townships are all located in R11E, 3rd P.M. and, in most places, are less than one section wide.

Closer at hand, note the top tier of sections in T23N, 4th P.M.; they are exceptionally long from north to south, being nearly 1.75 miles long and in some cases considerably less than a mile wide. Note especially Sec.6, T23N, R11E and Sec. 1, T23N, R10E on the Oregon 7.5-minute Quadrangle [42089A3]. The 3rd P.M. is situated 1.2 miles east of this stop, at the jog in Cottonwood Road. Meridian Road meets Cottonwood at that point. North of the Illinois River only east ranges are measured from the 3rd P.M.; everything to the west in that region is measured east from the 4th P.M. Therefore, from Sec. 13, T23N, R11E, 4th P.M. (note that this section is only 0.8 mile wide) you go slightly east into Sec. 31, T41N, R1E, 3rd P.M. (this section is slightly more than 0.9 mile wide). The early surveyors must have had themselves a real time in this area; about 2.75 miles north on Meridian from Cottonwood Road puts you at the northeast corner of T23N, R11E, 4th P.M. Here Sec. 1, T23N, R11E, 4th P.M. is 1.75 miles

long from north to south and 0.8 mile wide; just across the township line to the north, Sec. 36, T24N, R11E, 4th P.M. is 1.0 mile long from north to south, but only slightly more than 0.35 mile wide! Get out your quadrangle maps and have some fun. What other anomalies can you find? If your supply of topographic maps is limited, the Geological Survey will be happy to furnish you with a free index to topographic maps of Illinois. When you decide which ones you want and/or need, you may purchase them from the Survey.

END OF TRIP

To return home: **northwest and south**—retrace route for 1.35 miles to Chana macadam. Turn right (north) for 0.9 mile to SR 64 and then left (W) to Oregon, etc.. Turn left (south) through Chana for about 5.5 miles to SR 38 for Rochelle (E) or Dixon (W); **north and east**—continue ahead (E) on Cottonwood Road 1.2 miles to T-intersection of Meridian Road at slight jog in the road. Turn left (N) for 0.9 mile to SR 64 and then right (E) to SR 251, US 51/I 39.

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PLEISTOCENE GLACIATIONS IN ILLINOIS

Origin of the Glaciers

During the past million years or so, an interval of time called the Pleistocene Epoch, most of the northern hemisphere above the 50th parallel has been repeatedly covered by glacial ice. The cooling of the earth's surface, a prerequisite for glaciation, began at least 2 million years ago. On the basis of evidence found in subpolar oceans of the world (temperature-dependent fossils and oxygen-isotope ratios), a recent proposal has been made to recognize the beginning of the Pleistocene at 1.6 million years ago. Ice sheets formed in sub-arctic regions many times and spread outward until they covered the northern parts of Europe and North America. In North America, early studies of the glacial deposits led to the model that four glaciations could explain the observed distribution of glacial deposits. The deposits of a glaciation were separated from each other by the evidence of intervals of time during which soils formed on the land surface. In order of occurrence from the oldest to the youngest, they were given the names Nebraskan, Kansan, Illinoian, and Wisconsinan Stages of the Pleistocene Epoch. Work in the last 30 years has shown that there were more than four glaciations but the actual number and correlations at this time are not known. Estimates that are gaining credibility suggest that there may have been about 14 glaciations in the last one million years. In Illinois, estimates range from 4 to 8 based on buried soils and glacial deposits. For practical purposes, the previous four glacial stage model is functional, but we now know that the older stages are complex and probably contain more than one glaciation. Until we know more, all of the older glacial deposits, including the Nebraskan and Kansan will be classified as pre-Illinoian. The limits and times of the ice movement in Illinois are illustrated in the following pages by several figures.

The North American ice sheets developed when the mean annual temperature was perhaps 4° to 7°C (7° to 13°F) cooler than it is now and winter snows did not completely melt during the summers. Because the time of cooler conditions lasted tens of thousands of years, thick masses of snow and ice accumulated to form glaciers. As the ice thickened, the great weight of the ice and snow caused them to flow outward at their margins, often for hundreds of miles. As the ice sheets expanded, the areas in which snow accumulated probably also increased in extent.

Tongues of ice, called lobes, flowed southward from the Canadian centers near Hudson Bay and converged in the central lowland between the Appalachian and Rocky Mountains. There the glaciers made their farthest advances to the south. The sketch below shows several centers of flow, the general directions of flow from the centers, and the southern extent of glaciation. Because Illinois lies entirely in the central lowland, it has been invaded by glaciers from every center.

Effects of Glaciation

Pleistocene glaciers and the waters melting from them changed the landscapes they covered. The glaciers scraped and smeared the landforms they overrode, leveling and filling many of the minor valleys and even some of the larger ones. Moving ice carried colossal amounts of rock and earth, for much of what the glaciers wore off the ground was kneaded into the moving ice and carried along, often for hundreds of miles.

The continual floods released by melting ice entrenched new drainageways, deepened old ones, and then partly refilled both with sediments as great quantities of rock and earth were carried beyond the glacier fronts. According to some estimates, the amount of water drawn from the sea and changed into ice during a glaciation was enough to lower the sea level from 300 to 400 feet below present level. Consequently, the melting of a continental ice sheet provided a tremendous volume of water that eroded and transported sediments.

In most of Illinois, then, glacial and meltwater deposits buried the old rock-ribbed, low, hill-and-valley terrain and created the flatter landforms of our prairies. The mantle of soil material and the buried deposits of gravel, sand, and clay left by the glaciers over about 90 percent of the state have been of incalculable value to Illinois residents.

Glacial Deposits

The deposits of earth and rock materials moved by a glacier and deposited in the area once covered by the glacier are collectively called **drift**. Drift that is ice-laid is called **till**. Water-laid drift is called **outwash**.

Till is deposited when a glacier melts and the rock material it carries is dropped. Because this sediment is not moved much by water, a till is unsorted, containing particles of different sizes and compositions. It is also stratified (unlayered). A till may contain materials ranging in size from microscopic clay particles to large boulders. Most tills in Illinois are pebbly clays with only a few boulders. For descriptive purposes, a mixture of clay, silt, sand and boulders is called **diamicton**. This is a term used to describe a deposit that could be interpreted as till or a mass wasting product.

Tills may be deposited as **end moraines**, the arc-shaped ridges that pile up along the glacier edges where the flowing ice is melting as fast as it moves forward. Till also may be deposited as **ground moraines**, or **till plains**, which are gently undulating sheets deposited when the ice front melts back, or retreats. Deposits of till identify areas once covered by glaciers. Northeastern Illinois has many alternating ridges and plains, which are the succession of end moraines and till plains deposited by the Wisconsinan glacier.

Sorted and stratified sediment deposited by water melting from the glacier is called **outwash**. Outwash is bedded, or layered, because the flow of water that deposited it varied in gradient, volume, velocity, and direction. As a meltwater stream washes the rock materials along, it sorts them by size—the fine sands, silts, and clays are carried farther downstream than the coarser gravels and cobbles. Typical Pleistocene outwash in Illinois is in multilayered beds of clays, silts, sands, and gravels that look much like modern stream deposits in some places. In general, outwash tends to be coarser and less weathered, and alluvium is most often finer than medium sand and contains variable amounts of weathered material.

Outwash deposits are found not only in the area covered by the ice field but sometimes far beyond it. Meltwater streams ran off the top of the glacier, in crevices in the ice, and under the ice. In some places, the cobble-gravel-sand filling of the bed of a stream that flowed in the ice is preserved as a sinuous ridge called an **esker**. Some eskers in Illinois are made up of sandy to silty deposits and contain mass wasted diamicton material. Cone-shaped mounds of coarse outwash, called **kames**, were formed where meltwater plunged through crevasses in the ice or into ponds on the glacier.

The finest outwash sediments, the clays and silts, formed bedded deposits in the ponds and lakes that filled glacier-dammed stream valleys, the sags of the till plains, and some low, moraine-diked till plains. Meltwater streams that entered a lake rapidly lost speed and also quickly dropped the sands and gravels they carried, forming deltas at the edge of the lake. Very fine sand and silts were commonly redistributed on the lake bottom by wind-generated currents, and the clays, which stayed in suspension longest, slowly settled out and accumulated with them.

Along the ice front, meltwater ran off in innumerable shifting and short-lived streams that laid down a broad, flat blanket of outwash that formed an **outwash plain**. Outwash was also carried away from the glacier in valleys cut by floods of meltwater. The Mississiippi, Illinois, and Ohio Rivers occupy valleys that were major channels for meltwaters and were greatly widened and deepened during times of the greatest meltwater floods. When the floods waned, these valleys were partly filled with outwash far beyond the ice margins. Such outwash deposits, largely sand and gravel, are known as **valley trains**. Valley train deposits may be both extensive and thick. For instance, the long valley train of the Mississippi Valley is locally as much as 200 feet thick.

Loess, Eolian Sand and Soils

One of the most widespread sediments resulting from glaciation was carried not by ice or water but by wind. **Loess** is the name given to windblown deposits dominated by silt. Most of the silt was derived from wind erosion of the valley trains. Wind action also sorted out **eolian sand** which commonly formed **sand dunes** on the valley trains or on the adjacent uplands. In places, sand dunes have migrated up to 10 miles away from the principle source of sand. Flat areas between dunes are generally underlain by eolian **sheet sand** that is commonly reworked by water action. On uplands along the major valley trains, loess and eolian sand are commonly interbedded. With increasing distance from the valleys, the eolian sand pinches out, often within one mile.

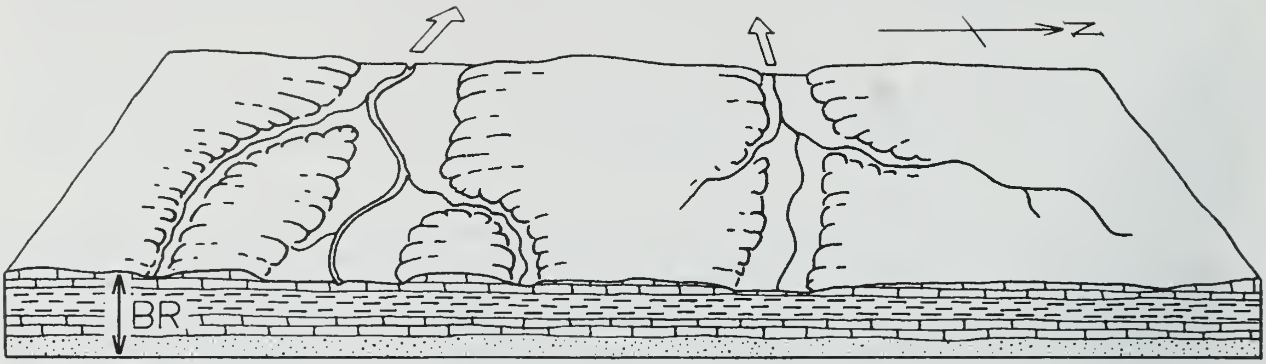
Eolian deposition occurred when certain climatic conditions were met, probably in a seasonal pattern. Deposition could have occurred in the fall, winter or spring season when low precipitation rates and low temperatures caused meltwater floods to abate, exposing the surfaces of the valley trains and permitting them to dry out. During Pleistocene time, as now, west winds prevailed, and the loess deposits are thickest on the east sides of the source valleys. The loess thins rapidly away from the valleys but extends over almost all the state.

Each Pleistocene glaciation was followed by an interglacial stage that began when the climate warmed enough to melt the glaciers and their snowfields. During these warmer intervals, when the climate was similar to that of today, drift and loess surfaces were exposed to weather and the activities of living things. Consequently, over most of the glaciated terrain, soils developed on the Pleistocene deposits and altered their composition, color, and texture. Such soils were generally destroyed by later glacial advances, but some were buried. Those that survive serve as "key beds," or stratigraphic markers, and are evidence of the passage of a long interval of time.

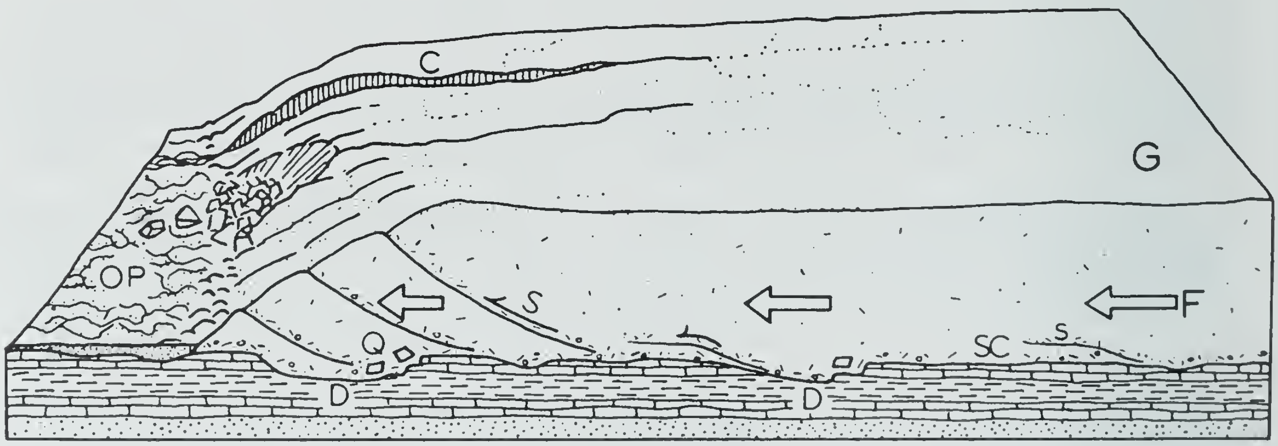
Glaciation in a Small Illinois Region

The following diagrams show how a continental ice sheet might have looked at various stages as it moved across a small region in Illinois. They illustrate how it could change the old terrain and create a landscape like the one we live on. To visualize how these glaciers looked, geologists study the landforms and materials left in the glaciated regions and also the present-day mountain glaciers and polar ice caps.

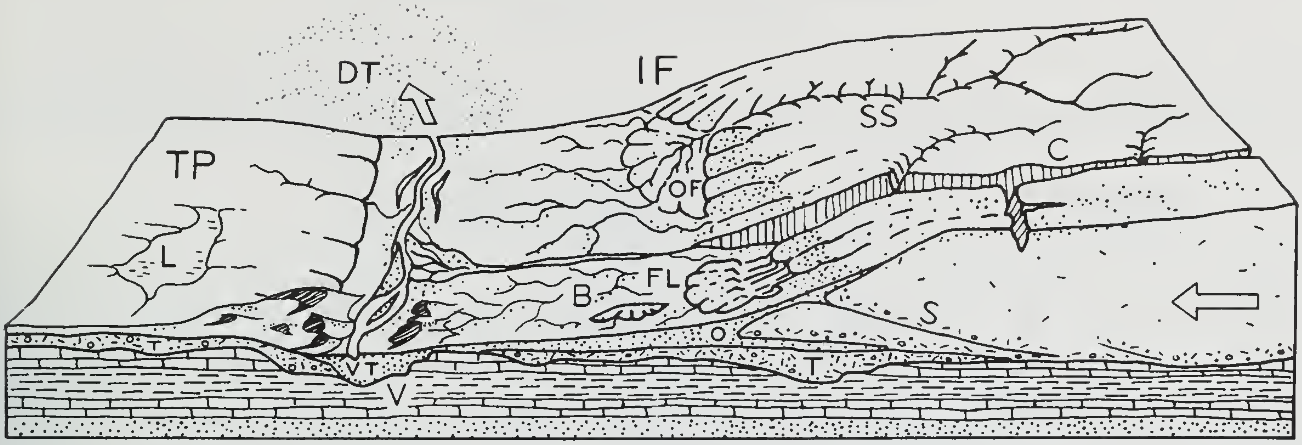
The block of land in the diagrams is several miles wide and about 10 miles long. The vertical scale is exaggerated—layers of material are drawn thicker and landforms higher than they ought to be so that they can be easily seen.



1. **The Region Before Glaciation** — Like most of Illinois, the region illustrated is underlain by almost flat-lying beds of sedimentary rocks—layers of sandstone ( ), limestone ( ), and shale ( ). Millions of years of erosion have planed down the bedrock (BR), creating a terrain of low uplands and shallow valleys. A residual soil weathered from local rock debris covers the area but is too thin to be shown in the drawing. The streams illustrated here flow westward and the one on the right flows into the other at a point beyond the diagram.



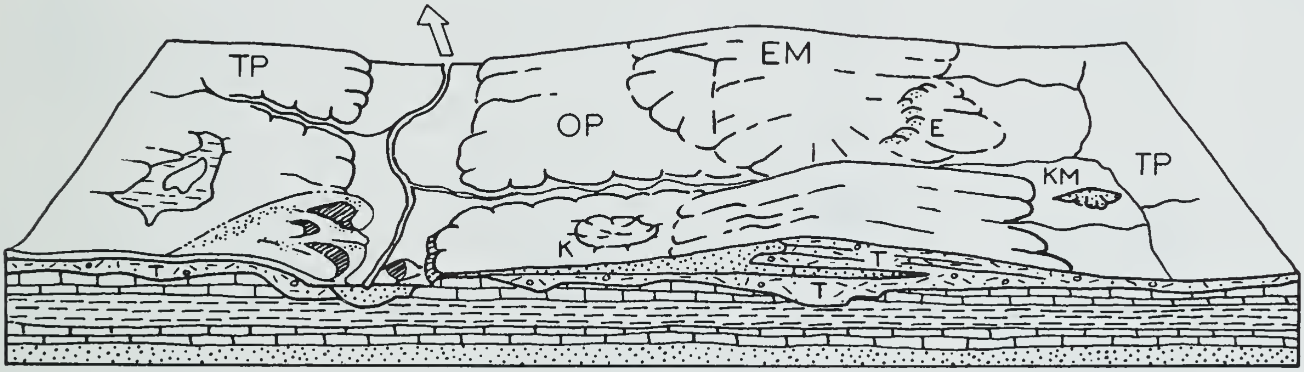
2. **The Glacier Advances Southward** — As the Glacier (G) spreads out from its ice snowfield accumulation center, it scours (SC) the soil and rock surface and quarries (Q)—pushes and plucks up—chunks of bedrock. The materials are mixed into the ice and make up the glacier's "load." Where roughnesses in the terrain slow or stop flow (F), the ice "current" slides up over the blocked ice on innumerable shear planes (S). Shearing mixes the load very thoroughly. As the glacier spreads, long cracks called "crevasses" (C) open parallel to the direction of ice flow. The glacier melts as it flows forward, and its meltwater erodes the terrain in front of the ice, deepening (D) some old valleys before ice covers them. Meltwater washes away some of the load freed by melting and deposits it on the outwash plain (OP). The advancing glacier overrides its outwash and in places scours much of it up again. The glacier may be 5000 or so feet thick, and tapers to the margin, which was probably in the range of several hundred feet above the old terrain. The ice front advances perhaps as much as a third of a mile per year.



3. **The Glacier Deposits an End Moraine** — After the glacier advances across the area, the climate warms and the ice begins to melt as fast as it advances. The ice front (IF) is now stationary, or fluctuating in a narrow area, and the glacier is depositing an end moraine.

As the top of the glacier melts, some of the sediment that is mixed in the ice accumulates on top of the glacier. Some is carried by meltwater onto the sloping ice front (IF) and out onto the plain beyond. Some of the debris slips down the ice front in a mudflow (FL). Meltwater runs through the ice in a crevasse (C). A supraglacial stream (SS) drains the top of the ice, forming an outwash fan (OF). Moving ice has overridden an immobile part of the front on a shear plane (S). All but the top of a block of ice (B) is buried by outwash (O).

Sediment from the melted ice of the previous advance (figure 2) remains as a till layer (T), part of which forms the till plain (TP). A shallow, marshy lake (L) fills a low place in the plain. Although largely filled with drift, the valley (V) remains a low spot in the terrain. As soon as the ice cover melts, meltwater drains down the valley, cutting it deeper. Later, outwash partly refills the valley: the outwash deposit is called a valley train (VT). Wind blows dust (DT) off the dry floodplain. The dust will form a loess deposit when it settles. Sand dunes (D) form on the south and east sides of streams.



4. **The Region after Glaciation** — As the climate warms further, the whole ice sheet melts, and glaciation ends. The end moraine (EM) is a low, broad ridge between the outwash plain (OP) and till plains (TP). Run-off from rains cuts stream valleys into its slopes. A stream goes through the end moraine along the channel cut by the meltwater that ran out of the crevasse in the glacier.

Slopewash and vegetation are filling the shallow lake. The collapse of outwash into the cavity left by the ice block's melting has made a kettle (K). The outwash that filled a tunnel draining under the glacier is preserved in an esker (E). The hill of outwash left where meltwater dumped sand and gravel into a crevasse or other depression in the glacier or at its edge is a kame (KM). A few feet of loess covers the entire area but cannot be shown at this scale.

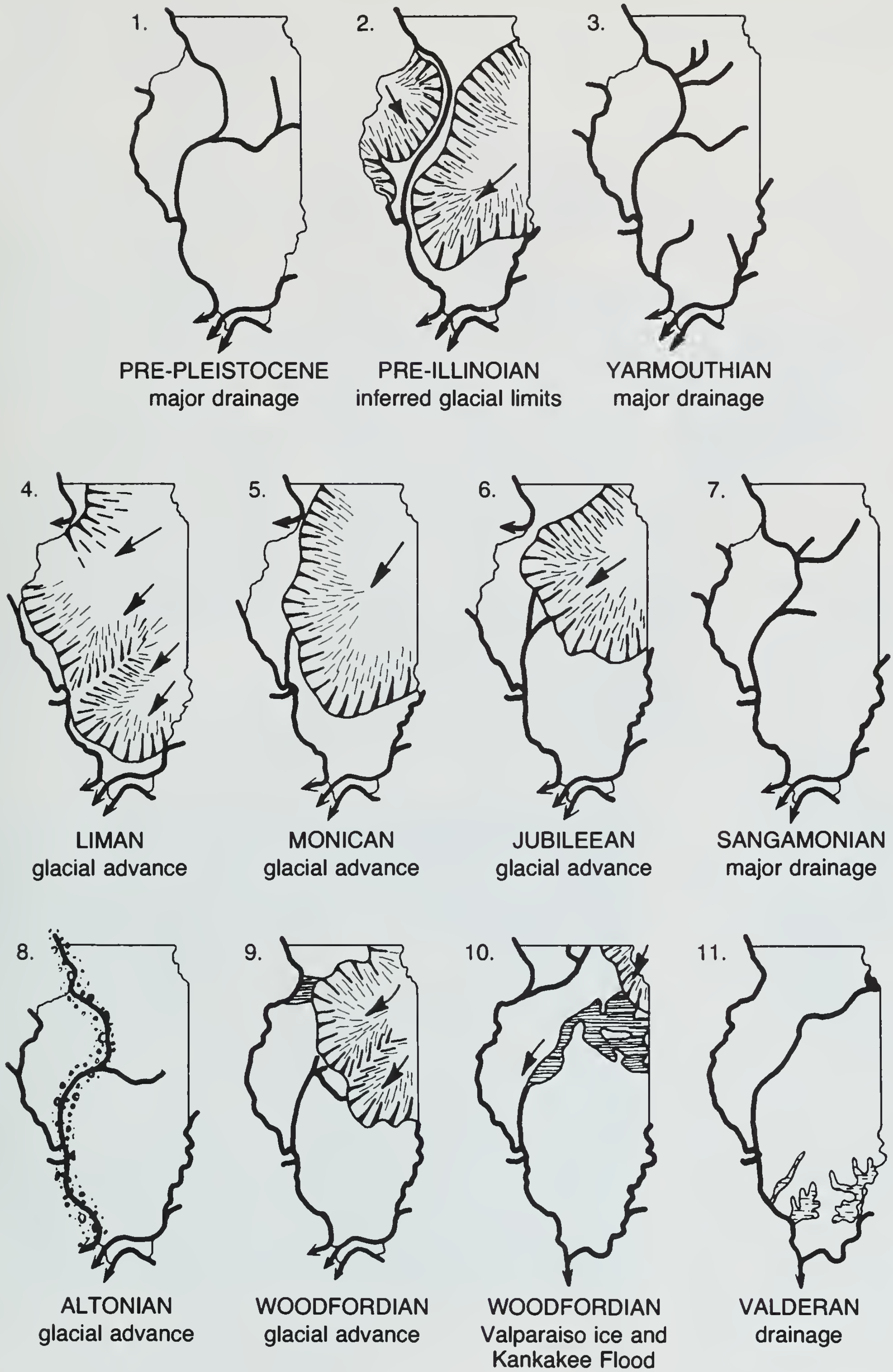
TIME TABLE OF PLEISTOCENE GLACIATION

		STAGE		SUBSTAGE	NATURE OF DEPOSITS	SPECIAL FEATURES
QUATERNARY		HOLOCENE (interglacial)		Years Before Present	Soil, youthful profile of weathering, lake and river deposits, dunes, peat	
				10,000		
	Pleistocene	WISCONSINAN (glacial)	late	Valderan	Outwash, lake deposits	Outwash along Mississippi Valley
				11,000		
				Twocreekan	Peat and alluvium	Ice withdrawal, erosion
				12,500		
				Woodfordian	Drift, loess, dunes, lake deposits	Glaciation; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes
				25,000		
			mid	Farmdalian	Soil, silt, and peat	Ice withdrawal, weathering, and erosion
				28,000		
			early	Altonian	Drift, loess	Glaciation in Great Lakes area, valley trains along major rivers
				75,000		
		SANGAMONIAN (interglacial)			Soil, mature profile of weathering	Important stratigraphic marker
				125,000		
		ILLINOIAN (glacial)		Jubileean	Drift, loess, outwash	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
				Monican	Drift, loess, outwash	
				Liman	Drift, loess, outwash	
				300,000?		
		YARMOUTHIAN (interglacial)			Soil, mature profile of weathering	Important stratigraphic marker
				500,000?		
		Pre-Illinoian: KANSAN* (glacial)			Drift, loess	Glaciers from northeast and northwest covered much of state
				700,000?		
		Pre-Illinoian: AFTONIAN* (interglacial)			Soil, mature profile of weathering	(hypothetical)
				900,000?		
		Pre-Illinoian: NEBRASKAN* (glacial)			Drift (little known)	Glaciers from northwest invaded western Illinois
				1,600,000 or more		

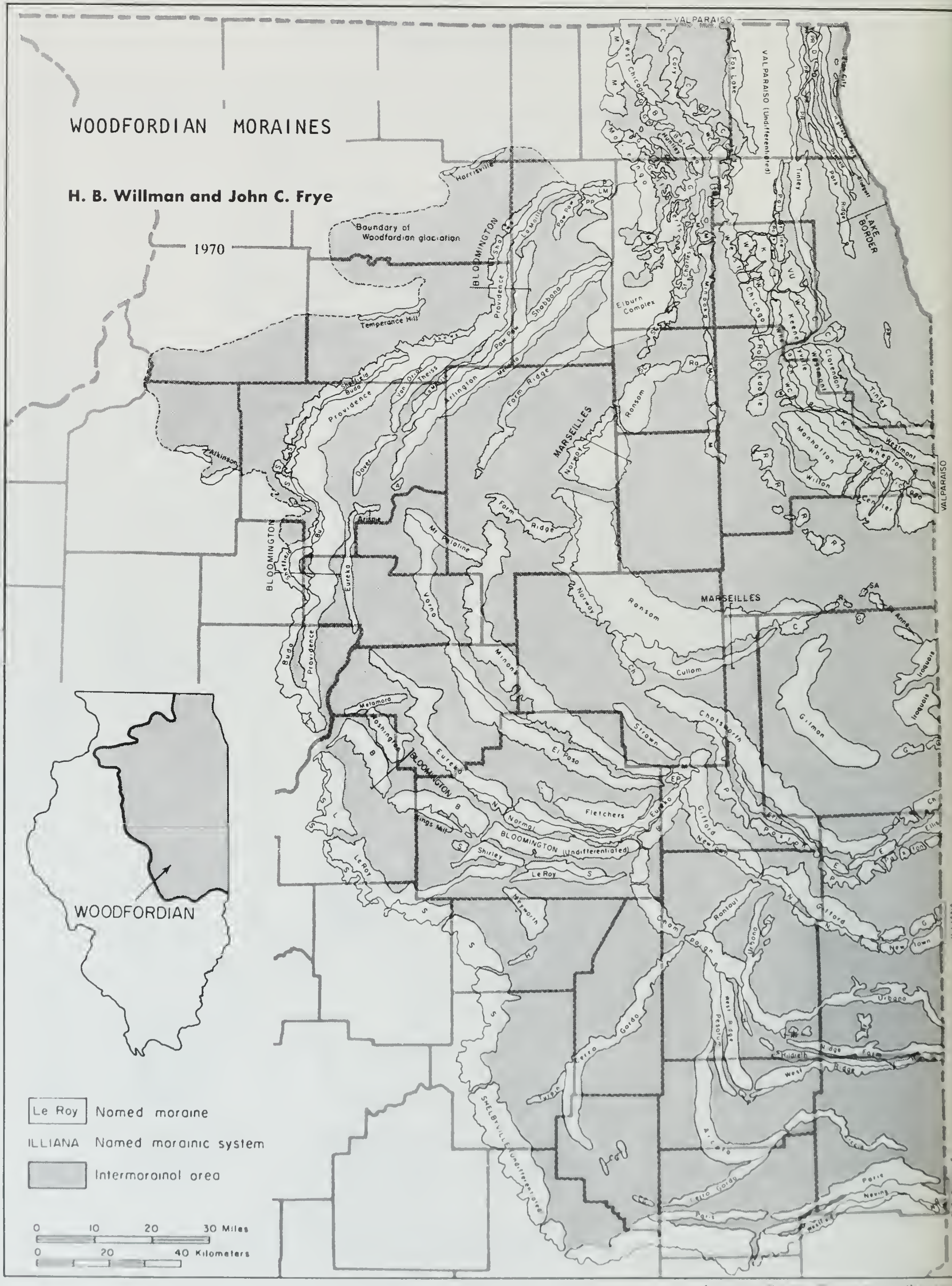
*Old oversimplified concepts, now known to represent a series of glacial cycles.

(Illinois State Geological Survey, 1973

SEQUENCE OF GLACIATIONS AND INTERGLACIAL DRAINAGE IN ILLINOIS



(Modified from Willman and Frye, "Pleistocene Stratigraphy of Illinois," ISGS Bull. 94, fig. 5, 1970.)


WOODFORDIAN MORAINES
H. B. Willman and John C. Frye
1970
Boundary of Woodfordian glaciation
Le Roy Named moraine
ILLIANA Named morainic system
Intermorainal area
0 10 20 30 Miles
0 20 40 Kilometers
WOODFORDIAN
VALPARAISO
VALPARAISO (Undifferentiated)
LAKE BORDER
BLOOMINGTON
BLOOMINGTON (Undifferentiated)
MARSEILLES
ILLIANA
SHELBYVILLE
SHELBYVILLE (Undifferentiated)
Harrisville
Temperance Hill
Atkinson
Sheffield
Buda
Providence
Van Orin
Theiss
Arlington
Paw Paw
Shabbona
Farm Ridge
Dover
Eureka
Mt Palatine
Varna
Minonk
Metamora
Washington
El Paso
Fletchers
Normal
Shirley
Le Roy
Heyworth
Ransom
Norway
Cullom
Chatsworth
Strawn
Gilman
Iroquois
Gifford
Newtown
Paxton
Rantoul
Champaign
Urbana
West Ridge
Pesotum
Cerro Gordo
Arcola
Paris
Nevins
Hildreth
Elburn Complex
West Chicago
Cary
Fox Lake
Huntley
St Charles
Minooka
Rockdale
Keeneyville
Westmont
Clarendon
Tinley
Manhattan
Wilton
Wheaton
Crete
Park Ridge
Deerfield
Highland Park
Blodgett

ILLINOIS STATE GEOLOGICAL SURVEY
Urbana. Illinois 61801

GEOGRAM 2
October 1974

ERRATICS ARE ERRATIC

Myrna M. Killey

You may have seen them scattered here and there in Illinois—boulders, some large, some small, lying alone or with a few companions in the corner of a field, at the edge of a road, in someone's yard, or perhaps on a courthouse lawn or schoolyard. Many of them seem out of place, like rough, alien monuments in the stoneless, grassy knolls and prairies of our state. Some—the colorful and glittering granites, banded gneisses, and other intricately veined and streaked igneous and metamorphic rocks—are indeed foreign rocks, for they came from Canada and the states north of us. Others—gray and tan sedimentary rocks—are native rocks and may be no more than a few miles from their place of origin. All of these rocks are glacial boulders that were moved to their present sites by massive ice sheets that flowed across our state. If these boulders are unlike the rocks in the quarries and outcrops in the region where they are found, they are called erratics.

The continental glaciers of the Great Ice Age scoured and scraped the land surface as they advanced, pushing up chunks of bedrock and grinding them against each other or along the ground surface as the rock-laden ice sheets pushed southward. Hundreds of miles of such grinding, even on such hard rocks as granite, eventually rounded off the sharp edges of these passengers in the ice until they became the rounded, irregular boulders we see today. Although we do not know the precise manner in which erratics reached their present isolated sites, many were probably dropped directly from the melting front of a glacier. Others may have been rafted to their present resting places by icebergs on ancient lakes or on the floodwaters of some long-vanished stream as it poured from a glacier. Still others, buried in the glacial deposits, could have worked their way up to the land surface as the surrounding loose soil repeatedly froze and thawed. When the freezing ground expands, pieces of rock tend to be pushed upward, where they are more easily reached by the farmer's plow and also more likely to be exposed by erosion.


An eight-foot boulder of pink granite left by a glacier in the bed of a creek about 5 miles southwest of Alexis, Warren County, Illinois. (From ISGS Bulletin 57, 1929.)

Generally speaking, erratics found northeast of a line drawn from Freeport in Stephenson County, southward through Peoria, and then southeastward through Shelbyville to Marshall at the east edge of the state were brought in by the last glacier to enter Illinois. This glaciation, called the Wisconsinan, spread southwestward into Illinois from a center in eastern Canada, reaching our state about 75,000 years ago and (after repeated advances and retreats of the ice margin) melting from the state about 12,500 years ago. Erratics to the west or south of the great arc outlined above were brought in by a much older glacier, the Illinoian, which spread over most of the state about 300,000 to 175,000 years ago. Some erratics were brought in by even older glaciers that came from the northwest.

You may be able to locate some erratics in your neighborhood. Sometimes it is possible to tell where the rock originally came from by determining the kind of rock it is. A large boulder of granite, gneiss, or other igneous or metamorphic rock may have come from the Canadian Shield, a vast area in central and eastern Canada where rocks of Precambrian age (more than 600 million years old) are exposed at the surface. Some erratics containing flecks of copper were probably transported here from the "Copper Range" of the upper peninsula of Michigan. Large pieces of copper have been found in glacial deposits of central and northern Illinois. Light gray to white quartzite boulders with beautiful, rounded pebbles of red jasper came from a very small outcrop area near Bruce Mines, Ontario, Canada. Purplish pieces of quartzite, some of them banded, probably originated in the Baraboo Range of central Wisconsin. Most interesting of all are the few large boulders of Canadian tillite. Tillite is lithified (hardened into rock) glacial till deposited by a Precambrian glacier many millions of years older than the ones that invaded our state a mere few thousand years ago. Glacial till is an unsorted and unlayered mixture of clay, sand, gravel, and boulders that vary widely in size and shape. Tillite is a gray to greenish gray rock containing a mixture of grains of different sizes and scattered pebbles of various types and sizes.

Many erratics are of notable size and beauty, and in parts of Illinois they are commonly used in landscaping. Some are used as monuments in courthouse squares, in parks, or along highways. Many are marked with metal plaques to indicate an interesting historical spot or event. Keep an eye out for erratics. There may be some of these glacial strangers in your neighborhood that would be interesting to know.

ILLINOIS STATE GEOLOGICAL SURVEY
Urbana, Illinois 61801

GEOGRAM 5
October 1975

ANCIENT DUST STORMS IN ILLINOIS

Myrna M. Killey

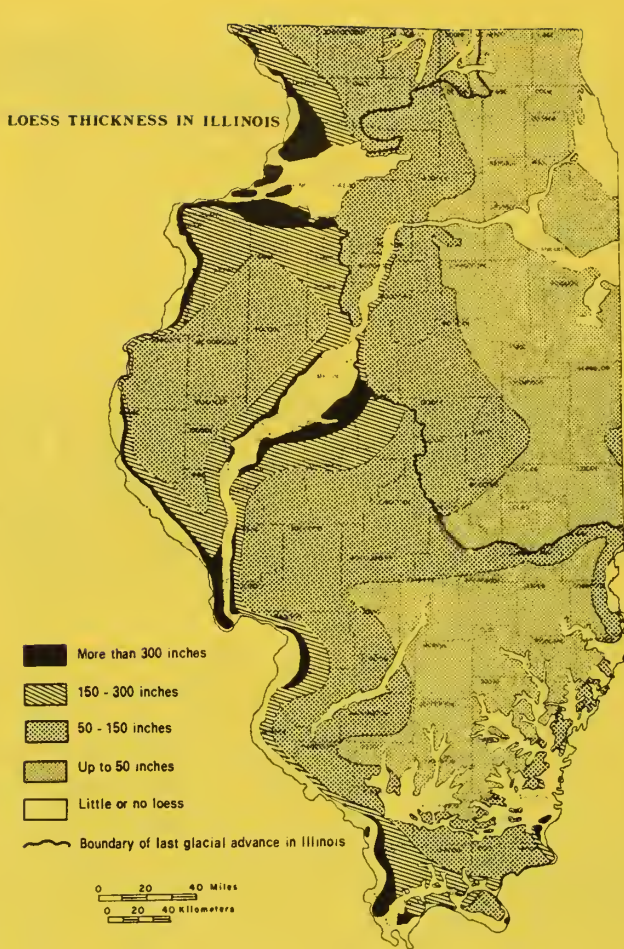
Fierce dust storms whirled across Illinois long before human beings were here to record them. Where did all the dust come from? Geologists have carefully put together clues from the earth itself to get the story. As the glaciers of the Great Ice Age scraped and scoured their way southward across the landscape from Canada, they moved colossal amounts of rock and earth. Much of the rock ground from the surface was kneaded into the ice and carried along, often for hundreds of miles. The glaciers acted as giant grist mills, grinding much of the rock and earth to "flour"—very fine dust-sized particles.

During the warm seasons, water from the melting ice poured from the glacier front, laden with this rock flour, called silt. In the cold months the meltwater stopped flowing and the silt was left along the channels the water had followed, where it dried out and became dust. Strong winds picked up the dust, swept it from the floodplains, and carried it to adjacent uplands. There the forests along the river valleys trapped the dust, which became part of the moist forest soil. With each storm more material accumulated until the high bluffs adjacent to major rivers were formed. The dust deposits are thicker along the eastern sides of the valleys than they are on the western sides, a fact from which geologists deduce that the prevailing winds of that time blew from west to east, the same direction as those of today. From such clues geologists conclude that the geologic processes of the past were much like those of today.

The deposits of windblown silt are called loess (rhymes with "bus"). Loess is found not only in the areas once covered by the glaciers but has been blown into the nonglaciated areas. The glaciers, therefore, influenced the present land surface well beyond the line of their farthest advance.

Loess has several interesting characteristics. Its texture is so fine and uniform that it can easily be identified in roadcuts—and because it blankets such a vast area many roads are cut through it. Even more noticeable is its tendency to stand in vertical walls. These steep walls develop as the loess drains and becomes tough, compact, and massive, much like a rock. Sometimes cracks develop in the loess, just as they do in massive limestones and sandstones. Loess makes good highway banks if it is cut vertically. A vertical cut permits maximum drainage because little surface is exposed to rain, and rainwater tends to drain straight down through it to the rock underneath. If the bank is cut at an angle more water soaks in, which causes the loess to slump down. Along Illinois roads the difference between a loess roadcut and one in ordinary glacial till is obvious. The loess has a very uniform texture, while the till is composed of a random mixture of rock debris, from clay and silt through cobbles and boulders.

Many loess deposits are worth a close look. Through a 10-power hand lens separate grains can be seen, among them many clear, glassy, quartz grains. Some loess deposits contain numerous rounded, lumpy stones called concretions. Their formation began when water percolating through the loess dissolved tiny



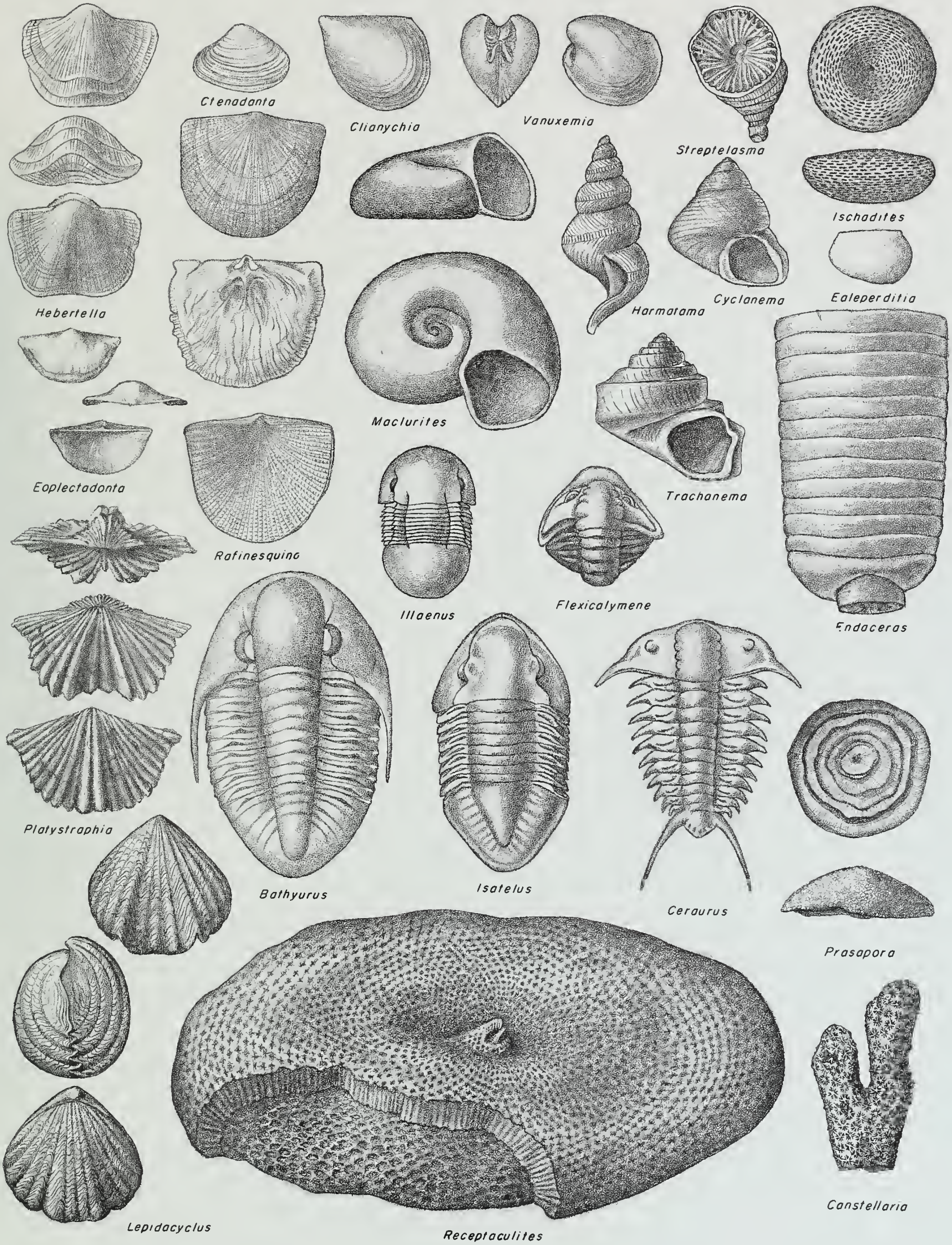
limestone grains. Some of the dissolved minerals later became solid again, gathering around a tiny nucleus or along roots to form the lumpy masses. A few such concretions are shaped roughly like small dolls and, from this resemblance, are called "loess kindchen," a German term meaning "loess children." They may be partly hollow and contain smaller lumps that make them rattle when shaken.

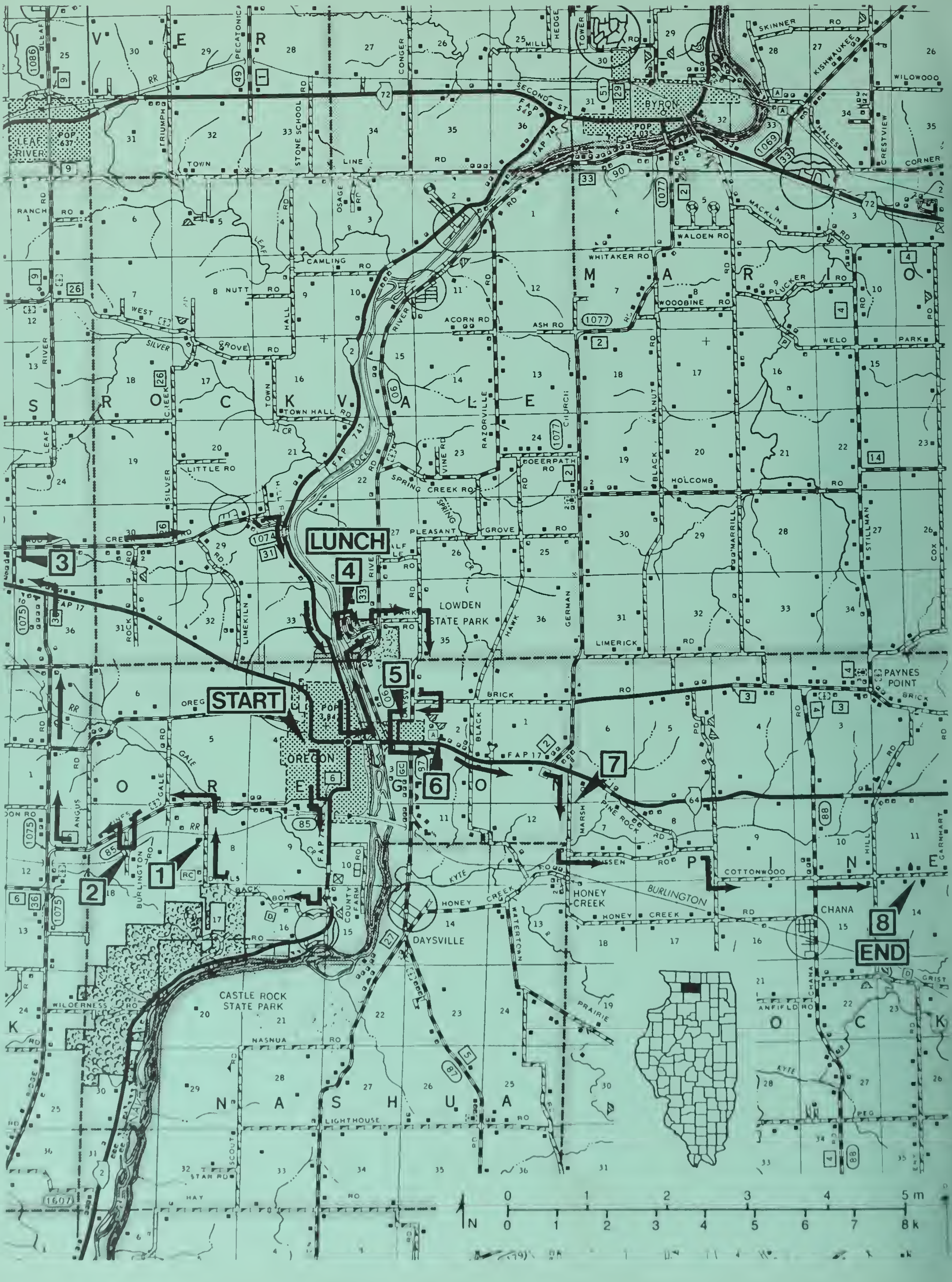
Fossil snails can be found in some loess deposits. The snails lived on the river bluffs while the loess was being deposited and were buried by the dust. When they are abundant, they are used to determine how old the loess is. The age is found by measuring the amount of radioactive carbon in the calcium carbonate of their shells.

Some of the early loess deposits were covered by new layers of loess following later glacial invasions. Many thousands of years passed between the major glacial periods, during which time the climate was as warm as that of today. During the warm intervals, the surface of the loess and other glacial deposits was exposed to weather. Soils developed on most of the terrain, altering the composition, color, and texture of the glacial material. During later advances of the ice, some of these soils were destroyed, but in many places they are preserved under the younger sediments. Such ancient buried soils can be used to determine when the materials above and below them were laid down by the ice and what changes in climate took place.

The blanket of loess deposited by the ancient dust storms forms the parent material of the rich, deep soils that today are basic to the state's agriculture. A soil made of loess crumbles easily and has great moisture-holding capacity. It also is free from rocks that might complicate cultivation. Those great dust storms that swirled over the land many thousands of years ago thus endowed Illinois with one of its greatest resources, its highly productive soil.

ORDOVICIAN FOSSILS




START
LUNCH
END
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2
3
4
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7
8
OREGON
BYRON
POP 2,035
LEAF RIVER
POP 637
LOWDEN STATE PARK
CASTLE ROCK STATE PARK
PAYNES POINT
HONEY CREEK
DAYSVILLE
CHANA
ROCK RIVER
FAP 742
FAP 17
FAP 549
SECOND ST
BURLINGTON
PLEASANT GROVE RD
SPRING CREEK RD
LIMERICK RD
HOLCOMB RD
WHITAKER RD
WOODBINE RD
CAMLING RD
NUTT RD
WEST GROVE RD
TOWN HALL RD
LITTLE RD
ACORN RD
ASH RD
HONEY CREEK RD
COTTONWOOD RD
NASHUA RD
LIGHTHOUSE RD
STAR RD
HAY
WILDERNESS RD
MACKLIN RD
SKINNER RD
PLUCKER RD
WELO PARK RD
BRICK RD
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KYTE
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